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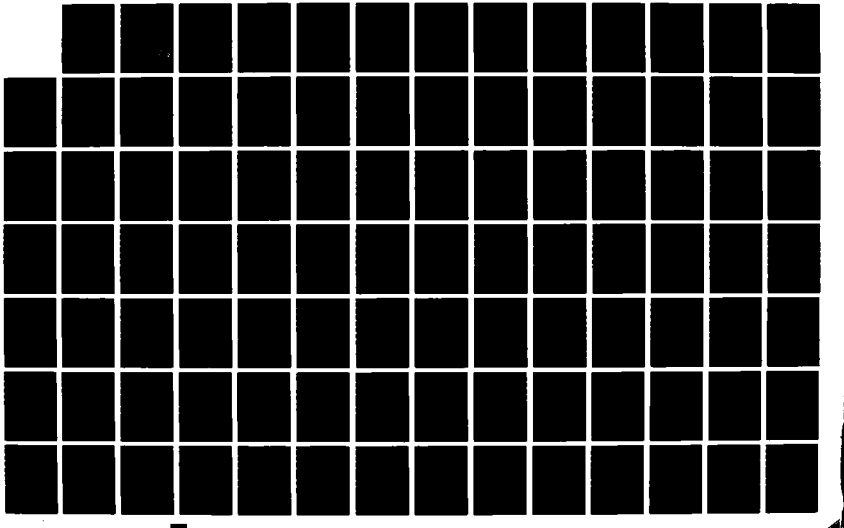

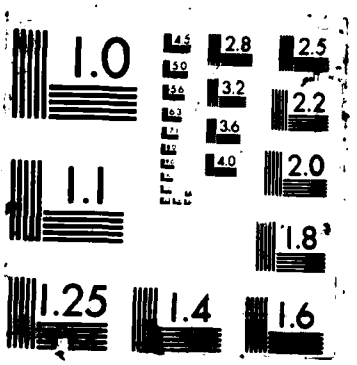
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AN ANALYSIS OF THE DEPOT MATERIAL MANAGEMENT OVERHEAD IN THE VAMOSC COMPONENT SUPPORT COST SYSTEM

THESIS

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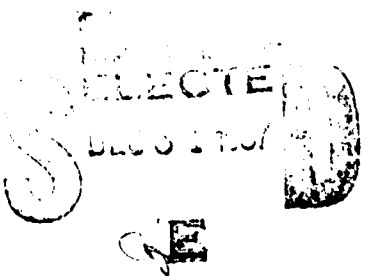

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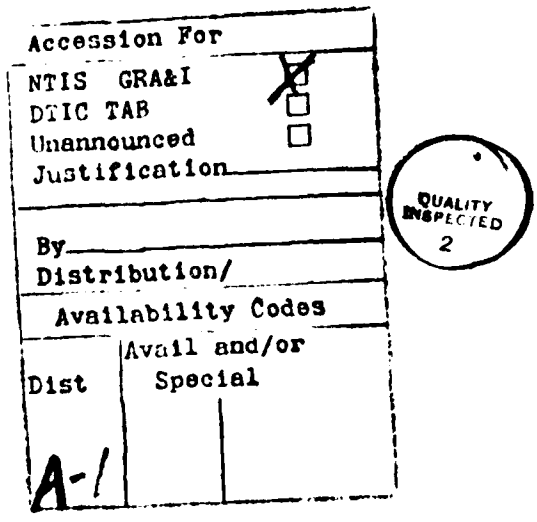

AFIT/GSM/LSY/87S-30

AN ANALYSIS OF THE DEPOT MATERIAL MANAGEMENT OVERHEAD IN THE VAMOSC COMPONENT SUPPORT COST SYSTEM

THESIS

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
Air University
In Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Systems Management

Cynthia Jo Lucas Sisco, B.A.
Captain, USAF

September 1987

Preface

The purpose of this research was to validate and document a factor used by the Visibility and Management of Operating Support Cost System (VAMOSC) to allocate depot material management costs to reparable aircraft component and subsystems. Congressional and Department of Defense interest in operating and support costs is increasing. Decision makers need good tools to analyze, estimate, and identify ways to reduce these costs. Validating and documenting this overhead factor is a step in this direction.

This research identified the activities and costs associated with depot material management and the most reasonable and equitable bases for allocating these costs. This in turn forms the basis for developing a factor to allocate material management costs to reparable aircraft items.

This study could not have been completed without the assistance of many good people. Their guidance and assistance will never be forgotten.

A special thanks goes to my thesis advisor, Major Bud Bowlin. This project couldn't have been completed without his quick turnaround, patience, and push. I am greatly indebted to Kyn Uptagraff, Senior Systems Analyst for Decisions Information Corporation. Kyn never got tired

of answering the same questions over and over again and was instrumental in guiding me through concepts that were key to this analysis. I won't forget Sharon Sutton, AFLC/ACB; I couldn't have found or made it through the budget information without her. Additional thanks go to Major Chuck Hanna, AFLC/ACCV, for providing this research topic and getting me started in the right direction. Finally, I'd like to recognize the people at the air logistics centers, the budget analysts, resource advisors, and Deputy Directors of the Resource Management Divisions. This research couldn't have been completed without their expertise and assistance.

I am deeply indebted to my fellow GCAs who brought light and humor into my life this past year. I couldn't have selected a better bunch of people to be with, and I am sorely going to miss them after graduation.

Lastly, a message to my father, "Yes Dad, I finally rang the bell!"

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Abstract

This research attempts to validate and document the factor used by the Visibility and Management of Operating and Support Cost (VAMOSC) System to allocate depot material management overhead to reparable aircraft components and subsystems. VAMOSC currently applies a factor of 21.7 percent to 14 different cost elements to allocate this cost.

This analysis defined material management and identified organizations engaged in this function at Headquarters Air Force Logistics Command and its air logistics centers at Oklahoma City, Ogden, San Antonio, Sacramento, and Warner Robins. Costs were collected, analyzed and refined to include only those costs related to the support of reparable aircraft items. This process resulted in the development of an overhead pool for material management activities.

The current VAMOSC algorithm was reviewed to determine the most equitable base for allocating material management overhead. An overhead base could not be developed because VAMOSC is currently experiencing problems with data collection. Since costs for an overhead base could not be collected, an overhead allocation factor could not be developed or documented.

Once these problems are corrected, the cost collected for this analysis will provide the basis for calculating a factor to allocate depot material management. In addition, this research documented a methodology for computing this factor.

AN ANALYSIS OF THE DEPOT MATERIAL MANAGEMENT OVERHEAD IN THE VAMOSC COMPONENT SUPPORT COST SYSTEM

I. Introduction

Chapter Overview

The Visibility and Management of Operating and Support Costs (VAMOSC) System is a data collection system, which captures cost information from existing Air Force data systems (feeder systems). This chapter introduces VAMOSC and defines the research problem associated with VAMOSC addressed in this thesis. In addition, justification for the research will be explained, research objectives and assumptions will be listed, and the study's scope will be detailed.

General Issue

In the past, VAMOSC has had limited use because of system problems and questions about data validity and credibility. The data generated by VAMOSC is only as accurate as the data it receives from feeder systems and the cost allocation algorithms. Algorithms have been analyzed and validated by independent contractors. The validity of the systems that feed VAMOSC has been questioned in several reports that will be discussed later in this chapter.

The Air Force Comptroller has tasked the Air Force Logistics Command (AFLC) Comptroller with getting the VAMOSC Program back on track (65:1). AFLC is in the process of resolving system problems. System validity is being improved by a review, update and, where required, documentation of algorithms and allocation factors.

Specific Problem

The Component Support Cost System (CSCS) of VAMOSC "gathers and computes support costs by assembly/subassembly and relates those costs back to an end item or a weapon system" (11:4). CSCS deals strictly with aircraft components and subsystems that have been designated reparable, which means they are economical to repair. As part of the cost tracking, CSCS algorithms allocate indirect costs associated with activities, such as base maintenance, base supply management, and depot material management, to these components and subsystems.

This research will deal specifically with procedures for allocating depot material management costs. In general terms, material management is defined as:

> Direction and control of those aspects of logistics which deal with material, including the functions of identification, cataloging, standardization, requirements determination, procurement, inspection, quality control, packaging, storage, distribution, disposal, maintenance, mobilization, planning, industrial readiness planning, and item management classification; encompasses material control, inventory control, inventory management and supply management [8:135].

The material management function at the depot will be discussed in greater detail in Chapter IV.

The CSCS system currently allocates depot material management costs by applying a factor of 21.7 percent to other cost categories related to base and depot maintenance functions. These cost categories include: time compliance technical order (TCTO) material, direct material, exchangeable repairs, exchangeable modifications, and condemnation spares. The algorithms for these cost categories will be discussed in greater detail in Chapter IV.

In 1984, Information Spectrum, Inc. (ISI) validated the algorithm used to allocate depot material management overhead. Their analysis indicated that there was a potential problem with the material management overhead factor. ISI made several attempts to track the development of the factor but were unsuccessful. In their final report, ISI questioned the appropriateness of the factor, identified what features should be included in the rate, and recommended that the development of the factor be documented (17:22).

Information on the current depot material management overhead factor is limited. The ISI study identified several problems concerning this overhead factor, which will be addressed in this thesis. They are as follows:

1. The material management factor of 21.7 percent has not been updated since 1980.

2. There is no documentation for exactly what depot costs are being allocated.

3. There is no documented method for calculating the material management overhead factor.

4. The bases being used to allocate depot material management costs may not make the most reasonable or equitable distribution.

VAMOSC has the potential to be a powerful management tool, but it will never reach this potential unless the system's accuracy and validity can be established. Updating and documenting the material management overhead factor is a step in this direction.

Definitions

Definitions for fundamental concepts presented in this paper are presented in Appendix A.

Background

Historical Perspective. The events that led to the development of VAMOSC began in the early 1960s. Acquisition costs were rising, operational and support costs were beginning to take a larger portion of the defense budget, and the Department of Defense (DoD) was seriously looking for ways to cut costs.

As operating and support (O&S) costs increased, DoD officials became concerned that these costs would eventually absorb the resources available for the acquisition of new weapon systems. By 1968, O&S costs exceeded acquisition costs by 50 percent (53:28-30). It was in this atmosphere that the concept of life cycle costs began to develop.

Robert Seldon presented one perspective of life cycle costs in his book Life Cycle Costing: A Better Method of Government Procurement:

> Life cycle costing is the search for product characteristics that result in large support costs; this presupposes that support costs are the major cost drivers (and they usually are). Life cycle cost is the search for significant costs that can be influenced by planning and design decisions. Therefore, a major task of life cycle cost analysis is to discover and illuminate such drivers [63:18].

The emphasis in this definition is identification of support costs which are cost drivers.

Following is the series of major acquisition events and directives issued that eventually led to development of VAMOSC:

1. 1967. Secretary of Defense directs all services to develop life cycle cost programs (36:2).

2. 1971-1972. DoDD 5000.1, Major System Acquisition. This directive is the cornerstone of the acquisition policy. It required that acquisition and ownership costs be established as cost parameters in the design requirements (16:1-3).

DoDD 5000.28, Design to Cost. This established cost as a design parameter along with performance, effectiveness, capacity, etc. Cost became an active factor as opposed to a resultant factor in the design phase (15).

DoDD 5000.2, Major System Acquisition Procedures. Established the requirement for life cycle cost estimates during the Secretary of Defense's Defense System Acquisition Review Council (DSARC) review process (16:1-3).

3. 1973. DoDD 5000.4, OSD Cost Analysis Improvement Group. Established the Cost Analysis Improvement Group (CAIG) to advise the DSARC. Provided the services VAMOSC's cost definition (41:4).

This brief synopsis of events indicates the major changes that took place in the acquisition process from the early 1960s through the mid 1970s. O&S costs received more and more attention with the development and implementation of life cycle costing. O&S costs became an active part of the design phase and contracts were no longer being awarded on the basis of lowest acquisition costs.

In 1975, W. P. Clemens, Jr., the Deputy Secretary of Defense, issued a memorandum entitled "Visibility and Management of Support Costs." This memorandum by objective, MBO 9-2, expressed Clemens' concern over rising O&S costs. The goal of the memorandum was to:

> . . . provide guidance to achieve support cost visibility and described characteristics of a management information system that would be required to provide the DoD long-term historical operating and support cost perspective [68:48].

This memorandum gave the services 90 days to solve the problem. The military departments were directed to develop systems that could capture data in a format "consistent with Department of Defense O&S costing guidance outlined several times by the Office of the Secretary of Defense, Cost Analysis Improvement Group (CAIG)" (19:96).

VAMOSC in the Early Days. In response to MBO 9-2, the Air Force developed two systems to track O&S costs. In 1976, the Operating and Support Cost Estimating Reference (OSCER) was developed by HQ USAF/ACMC to track O&S costs at the aircraft mission design series (MDS) level. In parallel, HQ USAF/LEYE contractually developed another system to track O&S costs at the type model series (TMS) level of detail for communications, electronic, and meteorological data (54:1-2). These two systems were besieged by problems from the start:

> Though both systems operated in accordance with their design specifications, hasty development of them resulted in coarse documentation and scant provisions for configuration management. Minimum resources were allowed for the development of the systems [31:2].

In 1979, the Air Force issued a Data Project Directive to consolidate these systems. AFLC was tasked to accomplish this objective which became known as VAMOSC.

VAMOSC Becomes Operational. VAMOSC became operational in 1982 and it was composed of three systems:

a. Weapon System Support Costs (WSSC), D160 data system--O&S costs of aircraft at the MDS, Mission-Design-Series, level of detail.
b. Ground-Communications-Electronics (C-E), D160A data system--ground based communications/electronics systems at TMS, Type-Model-Series, level of detail.
c. Component Support Cost System (CSCS), D160B data system--O&S costs of components of aircraft at NSN/WUC, national stock number/work unit code, level of detail [54:2].

VAMOSC collects cost information for each of these systems through a series of feeder data systems that interface with VAMOSC on a monthly, quarterly, or annual basis. In addition, it operates under the constraint that "no new data systems be developed, and all data sources must be existing DoD data sources" (54:4).

Validity Problems. All three of the VAMOSC subsystems receive data from aircraft maintenance information systems. Two studies have raised serious questions about the accuracy of the data collected by these information systems.

In 1978, Desmatics, Inc. was contracted by the VAMOSC program office to conduct a study to determine the accuracy of base level maintenance data. Desmatics' observers collected information on F-15 maintenance at Langley AFB and F-4D maintenance at MacDill AFB. Results of this study indicated that direct labor had been

over-reported by a factor of two. This was complicated by the fact that less than 50 percent of the work performed could be matched with work reported. The contractor concluded that this could be attributed to errors in reporting the work or the work could not have been reported (64: 35-36).

A 1983 GAO audit seriously questioned the accuracy of maintenance data collected:

> GAO found that errors are frequently made during the data recording. A substantial amount of the maintenance data is never collected because mechanics do not fill out the form to report their work. As a result, inaccurate data from the MDC systems receives extensive distribution with the Air Force [68:11].

The Weapon Systems Support Cost System and the Component Support Cost System receive data from the Maintenance Data Collection (MDC) System.

Maintenance data have received so much attention because maintenance costs constitute such a large portion of operating and support costs. The GAO audit and the report by Desmatics, Inc. raised serious questions about the validity and credibility of the aircraft maintenance data used by VAMOSC. The effect of this lack of credibility is reflected in one of the GAO audit conclusions, "We also believe that the VAMOSC system may not be used like its predecessors, until accurate input data is provided" (68:71).

Recent Developments. Congressional and Secretary of Defense (ODS) interest in O&S costs has continued to increase. In July 1986, representatives from the Secretary of the Air Force and Headquarters Air Force Comptroller met to assess the status of the Air Force's VAMOSC system and determine the feasibility of transferring responsiblity to the Comptroller community. Following are their findings and recommended actions:

1. There is a need for the type of O&S information that VAMOSC was established to prodice and that as primary user, transfer to the financial community is appropriate.

2. October 1986 is an opportune time to effect a transfer.

3. The VAMOSC Program Office, HQ AFLC/MML, should be reassigned to HQ AFLC/AC.

4. HQ AFLC should assist sufficient resources to the Program Office to insure that the VAMOSC work load is accomplished in a timely, responsive manner.

5. All contract actions currently in process and/ or planned through FY 87 should continue.

6. HQ USAF/AC and HQ AFLC/AC will construct a memorandum of agreement defining tasks and responsibilities (65:2).

In response to this tasking, the Comptroller of the Air Force designated the Air Force Cost Center (AFCCE) as

the Air Force office of primary responsibility for VAMOSC. HQ AFLC/AC was given operational program responsibilities.

In March 1987, The Analytical Sciences Corporation (TASC) completed a Get Well Modernization Plan for the VAMOSC System. The major findings were as follows:

1. Identified good CSCS data as the primary requirement.

2. Current user base is limited.

3. Principal problems with the system are lack of confidence in VAMOSC data, data currency, and the fact there is little "value-added" relative to the feeder systems.

4. The WSSC works. The outputs are reasonable but not accurate because of problems with source data and algorithms.

5. CSCS does not work well because the cross-reference system for work unit codes and national stock numbers does not work. This cross-reference system is the key to the CSCS system.

6. The C-E System has fundamental problems with data sources and allocation algorithms. In addition, there are very few users. TASC recommended C-E data processing and software development be suspended (22:9).

In response to TASC's study, AFLC/AC initiated the following actions:

1. Developed an automated system which cross-references work unit codes and national stock numbers in the CSCS system.

2. Developed a plan to transfer VAMOSC to a new computer. This new system will allow users to interface directly with the computer and upload and download information.

3. Requested that the Air Force Cost Center develop guidelines for VAMOSC.

4. Requested that the Air Force Cost Center conduct a feasibility study to determine if the WSSC information could be incorporated into AFR 173-13, U.S. Air Force Cost and Planning Factors.

5. Suspended data processing on the C-E system (23).

AFLC's immediate objective is getting CSCS operational because of the potential users and the fact that this system has not generated a report since 1984. Validating and documenting the material management overhead factor will help update the system and provide guidelines and methodology for updating it in the future.

Research Objectives

The objectives of this thesis are:

1. Identify what costs should be allocated for depot material management.

2. Review the algorithm currently used to allocate depot material management to identify which cost elements/ bases are equitably allocating the overhead.

3. Update/validate the factor currently used to allocate depot material management.

4. Develop and document a methodology for updating the material management overhead factor.

Research Questions

In order to accomplish the objectives of this research, the following questions must be answered:

1. What kind of direct costs are the material management overhead cost category trying to allocate?

2. On what base should the indirect costs be allocated?

3. Is the current material management overhead factor of 21.7 reasonable?

   a. Should the same factor be used to allocate costs at depot and base level?

   b. How often should this factor be updated?

Research Approach

The analysis will involve four distinct phases-- a literature review, development of an overhead pool, identification of base/bases to allocate the overhead pool, and the calculation of an overhead factor.

A literature review will be conducted to analyze current methods for allocating indirect costs. These methods will be compared to the current VAMOSC method of allocating overhead.

Material management will be defined so that depot (air logistics center) organizations associated with this function can be identified. Costs associated with these organizations will be collected excluding activities that are not related to reparable aircraft components and subsystems. The remaining costs will form the basis of the overhead pool.

The algorithm for depot material management overhead applies a fixed factor of 21.7 percent to 14 cost elements to produce an material management overhead cost at the component and MDS level. Each of the cost elements will be examined for similarities and differences and to determine if they are equitable base for allocating material management overhead. From this analysis the best base/bases for allocating the cost of material management will be selected.

The last phase of the analysis is to calculate a factor to allocate the overhead. The overhead pool and the base/bases selected during analysis will be used to develop the factor.

Report Organization

Chapter I briefly introduced VAMOSC and provides background information on the research problem associated with VAMOSC. A brief history was presented that detailed background events that led to the development of VAMOSC, problems with the system, and recent developments. Chapter II is a literature review that examines overhead/ indirect costs and the methodology and logic involved in allocating these costs. Chapter III details the methodology that was used in completing this report. Chapter IV is the analysis of the research problem and Chapter V presents conclusions and recommendations.

II. Literature Review

Chapter Overview

This chapter outlines the basic concepts associated with the allocation of overhead costs. The following areas are addressed: terms are defined, the objectives of cost allocation are discussed, current status of overhead costs is highlighted, costing methodology is covered and, finally, information on the nature of overhead, cost pools, and allocation bases is detailed.

Definitions and Terms

There are a number of terms that will be used throughout this chapter. The purpose of this section is to define key concepts and identify terms that can be interchanged and interrelated.

Cost data is accumulated into cost objectives. A cost objective is

> . . . a function, organizational subdivision, contract, or other work center for which cost data is desired and for which provision is made to accumulate, and measure the costs of service, products, jobs, projects, etc. [9:23].

Costs that are incurred for a specific objective are called direct costs. "Indirect costs are incurred for the benefit of two or more cost objectives" (74:91).

The terms overhead costs and indirect costs are used interchangeably. In his book Overhead, What It Is and How It Works, Jack Fultz defined overhead as the following:

> (1) those expenses incurred for the common good of several cost objectives and which cannot be reasonably or cost-effectively charged directly to specific cost objectives.
> (2) those expenses that could be allocated logically to specific cost objectives except that the benefit received is not in consonance with the cost distributed.
> (3) those expenses that are so minor as to make it impractical for both cost and time reasons to charge them directly to a particular cost objective [21:9].

In simpler terms, overhead are those costs which cannot directly or cost-effectively be charged to a cost objective. In addition, overhead may include costs which cannot be equitably distributed based on benefits received. After similar costs are accumulated together into overhead pools, they will subsequently be "allocated together to cost objectives" (45:77).

Objectives of Cost Allocation

In their book The Allocation of Corporate Indirect Costs, James M. Fremgen and Shu S. Liao identified four objectives of cost allocation: financial reporting, planning and decision making, pricing, and control and performance evaluation (20:16). In a survey of 123 companies, Fremgen and Liao found the primary objective for allocating costs was performance evaluation followed by financial reporting and a tie between pricing and decision making (20:45).

These objectives are discussed in greater detail in the subsequent paragraphs.

Financial Reporting. The primary objective in financial reporting is to "value assets and determine income" (45:183). This involves allocating overhead/ indirect costs to inventory and to segment reports.

Inventory costs are accumulated for income measurement in order to determine a per unit cost of production for inventory costing. The accrual method of accounting uses a production cost per unit to distribute total production cost between the cost of goods sold and the ending inventory.

Segment reports are "income statements that show operating results for portions or segments of a business" (45:357). When a company "produces several products, operates two or more plants, serves distinct groups of customers in geographical locations" (45:357), they produce segment reports to evaluate the income for these different entities.

Planning and Decision Making. Cost data are used by managers to make decisions about future events. This is the area of overhead costs that affects the DoD the most and is the area that this research will pursue. New weapon system estimates, contractor costs, and analysis of in-house

versus contract operations are just a few areas that involve a determination of overhead costs. The basis of these overhead costs and how they are allocated can have a major impact on planning and decision making.

Pricing. "Cost allocations are used to determine the appropriate selling prices" (45:183). However, costs are not the sole basis for pricing decisions. They provide a starting point. Competition and consumer demand play a larger role in price determination.

An area in the DoD related to pricing is cost analyses associated with Commercial Industrial Type Activities (CITA) reviews. Military work is accomplished using three methods: military members, civil service employees, and civilian contractors. When an activity or service is being considered for contract, the cost or price of performing it in-house must be compared with that of the contractor. In addition to costs that are directly related to the activity, other indirect/overhead costs such as general and administration costs and materiel management costs must be considered.

Performance Evaluation and Control. The purpose of cost allocation is to create an environment of cost awareness. There are often arguments against allocating indirect costs because managers can't control them. The

opposing argument is "that cost control requires management to be aware of all costs" (20:21).

For performance evaluation, overhead costs are sometimes divided into categories called controllable and noncontrollable costs. Controllable costs can be traced directly to the level of management responsible for them. Noncontrollable costs are allocated to cost centers but usually are controllable at a higher level of management.

A related article entitled "The Cost and Benefits of Cost Allocation" by Jerrold Zimmerman, presented a reason for allocating these uncontrollable costs. Zimmerman stated that a manager's utility or well-being was dependent on pecuniary and nonpecuniary factors. Nonpecuniary factors included items such as office size and decor and the number of people that work for an individual. If a manager is not satisfied with his pecuniary factors such as salary and benefits, he may increase his well-being by increasing his nonpecuniary factors. Zimmerman theorized when management's overhead costs are allocated to lower levels in an organization, it would provide incentives for subordinates to monitor their superior's consumption of these nonpecuniary items. If a superior's spending begins to affect a subordinate level, then the individuals at that level may question him directly or they may bypass him and go to his superior (75:509-519).

Overhead costs can be controlled through the budget process. The planning function of management sets objectives, goals and standards. Certain levels of overhead must be budgeted to meet company objectives (1:4.4).

Overhead Costs Today

Overhead costs have increased dramatically since the 1950s while direct costs have declined. The main cause of this increase in overhead costs has been an increase in support staffs and the rise in managers' salaries.

Sumer C. Aggarwal in his article "Manager, Manage Thyself!" identified one of the major reasons for economic decline was "the large number of overhead managers and their support staffs" (5:25). He used statistics from the 1950 Pennsylvania Business Survey to show how management salaries have increased in comparison to other occupations.

> During the early fifties, a middle manager in a U.S. corporation was getting a salary of $6,000-$7,000; a mechanic made about $2.00 per hour; an office worker $1.00 per hour; and a construction worker nearly $2.50 per hour. In comparison to that, during 1981 a middle manager made $50,000 to $60,000, whereas the mechanic made about $10 per hour, an office worker $5 an hour, and a construction worker $18 per hour. This means that during the last thirty years, the managerial salaries have gone up about eight times, whereas the workers' salaries have increased about five times. In addition, the benefits and perquisites now available to managers have increased at a higher proportion than the benefits available to lower-level employees [5:25-26].

Aggarwal concluded that

> . . . corporate staffs have been growing like amoebas in a warm pool. A hundred are doing what was once done by ten, and it seems as if one thousand will soon take the place of the hundred [5:26].

Aggarwal highlighted other pertinent statistics in an article entitled "Bulging Overheads Need Value Surgery."

> At present, nearly 90 percent of the American working population may be considered engaged in overhead types of jobs. Only the remaining 10 percent grow food, make goods, or dig out minerals. It is evident that the fast-growing numbers of attorneys, accountants, analysts, supervisors, managers and a host of other categories of staff personnel add little or very little to the value of outputs of goods or services. Most organizations incur anywhere from 30 to 70 percent of their total expenditures on overhead functions [4:14].

Aggarwal concluded the article by stating that

> . . . many overhead expenses remain hidden from the eyes of top management because they exist under hundreds of cost items and may be spread over a large number of account heads [5:21].

Individually these costs may seem insignificant but when they are combined they become a significant part of a company's operating expenses.

Methodology for Allocation of Indirect/Overhead Costs

In his book, The Allocation Problem in Financial Accounting Theory, Arthur Thomas identified three minimum requirements for what he called the "theoretical justification" of an allocation method. He believed that when an accountant prepares a financial report he has several different allocation methods available and he must theoretically defend or justify his choice.

Thomas' first requirement was that "an allocation method should not be unambiguous. It should yield an unique allocation" (67:7). The reason for the selection

of the method should be unquestionable when compared to other available methodologies. He also stated that "an allocation method should not leave one at a loss for how to allocate. Instead, it should provide clear instructions as to how the allocation should be conducted, and provide them in advance" (67:7).

Thomas felt that "it should be possible to defend the method" (67:8). He stated that this was a difficult proposition because "accounting's allocations cannot be defended by the physical proof possible in some of the sciences" (67:8).

The third requirement Thomas presented was that "the method should divide up what is available to be divided" (67:13). In other words it should allocate no more than is available to be divided.

Fremgen and Liao conducted a review of cost allocation literature for their book The Allocation of Corporate Indirect Costs. They identified six common criteria for allocating overhead costs which the literature on methodology addressed.

> 1. Fairness or equity. This is the basic criterion for allocating costs to defense contracts.
> 2. Benefit. Indirect costs should be allocated among cost objectives in proportion to the benefits that those cost objectives receive from the services for which the indirect costs occur.
> 3. Cause. Indirect costs should be allocated in proportion to whatever factor or factors cause those costs--if those causal factors are clearly identifiable in the cost objectives to which the allocation is to be made.

4. Neutrality. The neutrality criterion is intended to lead to the choice of allocation methods that avoids misleading information and, thus prevents inappropriate decisions and inefficient disputes.

5. Independence of cost objectives. The allocation method should be designed so that the amount of cost allocated to one cost objective is not affected by events in other cost objectives during the period for which the allocation is made.

6. Ability to bear costs should be allocated in proportion to cost objective's abilities to bear the charges for those costs. The premise is that bigger cost objectives can afford to bear larger shares of indirect costs [20:9-14].

Even though these criteria reappear in literature, Fremgen and Liao did not feel they answered all the questions concerning methodology. "It is one thing to state a reasonable sounding criteria, but it is quite another to translate it into an unambiguous allocation in a specific situation" (20:15). There is currently no established criteria for selecting allocation bases. Fremgen and Liao concluded that additional research in this area might not be of any value. They felt there was little evidence to indicate "that accountants might agree on how various criteria interact with each other or how to determine which criterion is dominant in a particular situation" (20:15).

Cost Pools

In production, indirect costs are divided into single or multiple overhead pools. Multiple overhead pools may be divided by service or functions (personnel, utilities, maintenance, etc.). Establishing cost pools is

expensive. Managers have to weigh the value of the data collected against the cost of its collection.

In his article "Bulging Overheads, Need Value Surgery," Summer Aggarwal stated that

> . . . efficient companies generally use a few overhead pools which may have designations such as plant facilities, maintenance pool, utilities pool, plant services (transport, purchasing, personnel) pool, and a few others [4:17].

The main advantage of a small number of pools is that it enables management closer constant supervision of these costs.

Aggarwal divided overhead functions or expenses into three categories: necessary and required overhead services, services whose tangible value is questionable, and popular but wasteful overhead items. Following is a breakdown of the expenses he allocated to those categories:

Necessary and Required Overhead Services:
- Accounting and auditing
- Personnel management
- R&D
- Corporate planning
- Plant engineering
- Sales and brand management
- Corporate offices and general management
- Depreciation of capital facilities

Services Whose Tangible Value is Questionable:
- Public relations office
- Corporate lawyers
- Advertisements
- In-house newspaper
- Productivity office/efficiency improvement office
- Training
- Elaborate audio visual services
- Superfluous data processing services

Popular Overhead Services
- Photocopying
- Telephones
- Entertainment
- Travel
- Luxury offices and personnel conference rooms
- Personal secretaries
- Corporate jets
- Expensive paintings and antiques [3:27]

Aggarwal felt that these costs are often not controlled because they are managers' pet projects. He stated that "it is not uncommon to find that several sections within the same organization are engaged in the same or nearly same type of overhead activity" [4:15].

Nature of Overhead

Overhead is usually classified into three categories: indirect labor, indirect material, and other indirect costs. Indirect labor includes the cost of supervisory and support personnel that cannot be linked directly to a specific cost objective. In manufacturing, indirect material is material which is too expensive to allocate or that cannot be assigned to specific units of production and may include items as brooms, buckets, lubricants, gloves, rivets, nails, and tool boxes. Other indirect costs may include machinery and tool maintenance and the cost of services departments such as accounting (1:14-16).

Allocation of Service Department Costs

Service departments do not engage directly in operations or production. They operate in support of these

functions. For example, the depot material management activity supports base and depot maintenance functions. VAMOSC is trying to allocate this cost to the component/ subassembly level.

If service costs are not allocated, there are several consequences which can occur:

> 1. More service will be demanded by user groups than is economically reasonable to supply.
> 2. It is difficult to determine if the service department is operating efficiently.
> 3. If a service department's output is not priced, there is little guidance on whether the firm should continue to supply the service internally.
> 4. In the absence of a pricing system, there is no simple way to decide on the quality of service to be provided [40:354].

Allocation of these costs allows a manager to control the consumption of these indirect costs in his department, provides a basis for comparing the cost of this service outside of the organization, and allows a line manager to make tradeoffs of cost versus the quality of service.

One method of allocating service costs is through the use of predetermined overhead rates. These rates are

> . . . developed by reviewing total costs and total activity of each service department during recent years. The rate is then set equal to or close to the actual rate of these previous periods [45:197].

As service department costs have become a bigger part of production costs, predetermined rates have become more popular. A predetermined rate "provides for rapid product costing, smooths out the bookkeeping workload, and

ensures that similar units produced in different months have similar product costs" (45:198).

General Overhead Formula

The general formula for calculating an overhead rate is as follows:

$$\text{Overhead Rate} = \frac{\text{Total Overhead}}{\text{Anticipated Activity}}$$

Total Overhead = Anticipated overhead costs for the period.

Anticipated Activity = Anticipated activity of the base selected to allocate the overhead i.e., direct labor cost, direct labor hours, machine hours, etc.

Once the rate is calculated, it is then applied against the actual activity of the base for the period.

Cost Allocation Bases

One of the most difficult problems in allocating overhead is to select a base or anticipated activity on which to allocate the overhead costs. Traditionally, direct labor has been the standard method for allocating costs, but as industry has become machine-intensive, this has started to change.

Wright and Bedingfield in their book Government Contract Accounting, identified three criteria for selecting a base for allocation. The base should cause a distribution "to the cost objectives in accord with (a) benefit

received, (b) reason for incurring the cost, or (c) logic and reason" (74:110). In addition, Wright and Bedingfield stated that the selected base must be common to all cost objectives to which the pool is distributed and it must vary directly with the amount of indirect expense allocated to each (74:110).

In his book Overhead, What It Is and How It Works, Jack Fultz listed some common expenses and their bases:

Expenses and Their Common Allocation Base (21:53)

Expense	Allocation Base
Telephone	Number of employees
Lights	Kilowatt hours
Power	Horsepower hours
Rent	Square or cubic footage
Repairs and maintenance	Square footage/number of machines assigned
Supervision	Number of people
Freight in	Direct material
Shop supplies	Direct labor
Small tools	Direct labor
Inspection labor	Direct labor
Depreciation on building	Square footage
Taxes	Book value assigned
Industrial relation & personnel	Number of people
Plant supervision	Department direct labor
Accounting	Relative value of products

This list is not all-inclusive. Some of the bases are interchangeable and other bases may exist for allocating these costs.

In December 1985, Henry Schwarzbach published an article entitled "The Impact of Automation on Accounting for Indirect Costs." The article summarized the results of a survey of 112 manufacturing firms that was taken to determine how companies track overhead costs and the effect

of automation on these practices. The companies were asked what bases they used to allocate their costs. Their response was as follows (62:46):

Allocation base	% of Firms Using the base
Direct labor hours	35.7
Direct labor dollars	58.0
Machine labor	27.7
Direct material cost	18.8
Weight	11.6
Other bases	8.9

The totals do not add to 100 percent because some companies use more than one base for allocating costs.

Another question that Schwarzbach asked the companies was why they selected these bases? Their response was as follows:

79 percent - There is a logical association between the basis and the overhead.

13 percent - We found a statistical relationship between the basis and the overhead.

3 percent - Other.

5 percent - Checked more than one answer (62:47). Schwarzbach concluded that accountants were looking for logical relationships as opposed to statistical relationships and since they did not validate their choices statistically that they would not change the bases as operations changed (62:47).

Advantages/Disadvantages of Various Allocation Bases

Direct Labor Dollars. As indicated earlier, direct labor is the most frequently used allocation base. The advantage to using direct labor is that it is economical and easy to use since the information may be obtained from payroll records. The disadvantages include:

1. The method makes no distinction between employees using expensive machinery and those using less expensive equipment, although the first group unquestionably creates higher indirect costs.
2. Distribution of indirect costs is influenced by differences in hourly wage rates and by differences in the speed of employees. Some jobs using high-priced labor or slow workers are unduly penalized being forced to absorb more than their fair share of indirect costs [6:79].

Direct Labor Hours. Allocation by direct labor hour is based on the assumption that "each hour of labor creates a certain amount of indirect costs" (6:79). The main advantage of this method is its use of time. Operations taking the same time are allocated an equal amount of overhead even though the speed and wages of the employees may differ (2:9.25). The main disadvantages of the direct labor hour method are:

1. It requires the additional information collection of labor hours by department or product.
2. It ignores the contribution of value to the product by factors other than direct labor [2:9.25].

Direct Material. The cost of direct material is sometimes used as basis for allocating overhead. This

method is simple and easy to use. It can give

> . . . reasonably accurate rates where the prices and grades of raw material do not differ widely, where quantity and cost of materials in each product is uniform, and where processing is uniform [2:9.37].

The disadvantages are:

> 1. There is no logical relationship between indirect manufacturing cost and the cost of raw materials used.
> 2. Where prices of raw materials differ widely, the products made from the items of high price are weighted with more than their share of overhead.
> 3. This method is inequitable when part of the materials passes through all processes, and part through only some processes [2:9.38].

Machine Hours. Machine hours are frequently used to allocate overhead when equipment is the main factor in the production or operation. The advantages of this method are:

> 1. From a cost accounting view, it affords the most accurate method of allocating overhead costs for each job.
> 2. From the engineering point of view, it provides an ideal method for estimating the cost of a job on a specification and route sheet with a high degree of accuracy.
> 3. From the marketing point of view, it makes it possible for the sales engineer to quote more accurate estimated selling prices for jobs.
> 4. From the management point of view, it involves the use of an overhead costing method that is scientific, logical, and theoretically sound, in addition to being practical, in its use. It also provides a basis for the measurement of the monthly cost of idle machines [2:9.32].

Arguments against the use of machine hours are as follows:

> 1. Additional information, not otherwise needed, must be provided in detail; i.e., machine times for

each operation. This increases the cost of the accounting procedure.

2. By its very nature, this method precludes the use of a blanket rate. Individual or group machine rates must be used, thus increasing the detailed cost work.

3. The machine hour rate is not universally applicable; it can be used only for costing operations performed by machinery [1:5.53].

Weight. Sometimes a physical measure of output is used to allocate overhead. Weight is often used in industries such as mining where the output of a product is measured in weight. This method is simple and direct when there is "only one product, or a few closely related products possessing a common denominator such as weight or volume" (2:9.32). The main disadvantage of this method is that it is only accurate "when actual overhead costs are closely related to the physical volume of the product" (1:5.56).

There are other types of bases used to allocate overhead. The bases covered in this section were those that are used most frequently in surveys taken of private industry.

Summary

This chapter looked at several aspects of cost allocation. Basic terms and concepts were defined. The four basic objectives of allocating indirect costs were discussed: financial reporting, planning and decision

making, pricing, and control and performance evaluation. Statistics were presented that showed how overhead costs are dramatically increasing. Requirements and criteria for allocating costs and the various types of cost pools were also addressed. The material management function was compared to a service department so information on allocating these types of costs were covered. A variety of information was reviewed concerning allocation bases: types, criteria for selecting a base, bases used in private industry, and the advantages and disadvantages of using different types of bases.

Chapter III presents the methodology used to complete this analysis. Three distinct steps are detailed: the development of an overhead pool, identification of a base/bases to allocate the overhead, and the calculation of an overhead factor.

III. Methodology

Overview

The VAMOSC Component Support Cost System (CSCS) captures the operating and support (O&S) costs for maintaining and supporting aircraft reparable subsystems and components. The purpose of this research is to validate and document the overhead factor used to allocate the cost of the depot material management function to these components and subsystems. This chapter details the methodology followed to calculate this factor. The data used to validate the factor will be defined and limitations and assumptions will be discussed.

Analysis Approach

The analysis will involve three distinct steps, the development of an overhead pool, the identification of the base to allocate the costs in the overhead pool, and the calculation of an overhead factor.

Overhead Pool Development

The first step in developing the overhead pool is to define depot material management and identify the activities which support this function at the air logistics centers (ALCs) and HQ AFLC. The definition is to be

approved by HQ AFLC VAMOSC/ACCV before further analysis is completed. Defining the function provides a basis for determining the allocation base and its relationship to the overhead cost pool by:

1. Standardizing and documenting the definition for depot material management.

2. Providing a basis for determining what costs should be allocated.

3. Guiding the cost to be collected in the allocation pool.

Cost Collection. Once material management is defined and the activities associated with the definition are identified, then costs associated with the definition are collected. There are several distinct steps in this process:

1. Material management organizations are reviewed and non-aircraft activities or those not engaged in supporting reparable subsystems or components are identified for elimination. This is because VAMOSC CSCS deals with the O&S costs of reparable aircraft subsystems and components.

2. Budget analysts assigned to the AFLC Comptroller Directorate and each of the air logistics centers provide cost information on operating and maintenance (O&M) expenses by using fiscal year-end budget reports.

3. Costs for non-aircraft component or subsystem activities are eliminated using year-end budget reports where possible. Costs are estimated for those organizations where the level of detail is not available.

4. Military pay costs are estimated using standard composite pay rates from AFR 173-13, Air Force Cost and Planning Factors.

The methodology for capturing these costs is contained in the following paragraphs.

The organizational structure at the air logistics centers and HQ AFLC is directorate level followed by division and then branch. For budget reporting purposes, the directorate corresponds to a responsibility center and division level equates to a cost center. A cost center is the lowest organizational level for which costs are collected. Thus, costs by branch are not captured.

Actual expenditures for FY 85 and 86 are collected and reimbursements for foreign military sales and other DoD agencies are excluded so that only direct expenditures are considered. FY 85 and 86 are used because FY 87 and 88 Financial Plans for each of the ALCs and HQ AFLC are available. In addition, plans are used because they provide detail and narrative by element of expense, and they can identify additional costs which should be deleted.

The primary program elements that fund material management activities are program element codes (PEC) 71111 and 71112. The ALC Financial Plans for FY 87 and 88 show actual expenditures for FY 85 and 86 for these PECs. These documents are reviewed to determine if there are additional costs which should be deleted from the allocation pool. These costs are deleted from the costs provided by the ALC's budget analysts. The subsequent totals are converted to base year FY 87 dollars. Conversion to FY 87 dollars allows for comparison of dollars that were spent in different fiscal years.

There are two different rates for converting O&M dollars to FY 87 constant dollars. For FY 85, the rate for civilian pay is 1.032, and the non-POL (petroleum, oil and lubricant) O&M rate is 1.074. The rates for FY 86 are 1.024 and 1.041 respectively (10:91-92). Figures provided by the ALCs will contain some POL expenses but they will be negligible and, therefore, the non-POL O&M rate will be applied to all non-civilian pay expenses. The portion of total cost that is attributed to civilian pay will be estimated based on each ALC's total civilian pay expenditures in PEC 71111 and 71112. The different adjustment rates will be applied based on this analysis.

Headquarters AFLC directorates are mainly funded from PEC 78298. Civilian pay accounted for 66.1 percent of

total in this PEC in FY 86 and 75.4 percent in FY 87 (34: 631; 35:609). This PEC will be reviewed and the same method previously described to convert expenses to base year FY 87 will be used to adjust HQ AFLC costs to FY 87 dollars.

Divisions and branches which are not engaged in supporting reparable aircraft components or subsystems are identified by reviewing current organizational charts. Costs for these divisions and branches are not included in the final costs to be allocated. Division costs can be readily identified since they are cost centers for budget reporting and thus, costs are collected at this level. However, costs are not identified at the branch level, and therefore an alternative method for determining these costs is used.

Branch costs are estimated using two steps. First, civilian pay is estimated based on authorizations. The civilian fill rate is estimated at 100 percent because as of 28 February 1987, AFLC had 88,967 authorizations and a 90,617 personnel assigned for a rate of 101 percent (25: 1-13). Base pay rates from AFLCP 173-10, Air Logistics Command Cost & Planning Factors, are then used to calculate the total wage expense for these branches. Since pay rates reflected in AFLCP 173-10 are for FY 85, they will be converted to FY 87 base year dollars by dividing by a factor of 1.032. Pay rates are then increased by 18 percent for

leave and holiday pay, 27.9 percent for retirement and 7.95 percent for benefits (10:42).

Second, an analysis of the major PEC which funds the branch will provide an estimate of the percent of total costs attributed to civilian pay expenses. Assuming a direct relationship between civilian pay and the other expenses, the remaining expenses will be estimated on a proportion basis. For example, if civilian pay is estimated to be $100,000 and it normally accounts for 80 percent of expenditures, total expenditures would total $125,000 ($100,000/.8).

The year-end budget reports summarize operating and maintenance obligations and include expenses for civilian pay, but do not include military pay. Hence, military pay is calculated based on authorizations and an assigned rate of 100 percent. As of February 1987, AFLC was authorized 11,978 military and had 11,982 personnel assigned for an assigned rate of 100 percent (25:1-13). Manpower authorizations are taken from the Extended Unit Manpower Document, Air Force Logistics Command.

Total cost for military personnel is calculated using the composite wage rates in AFR-173-13 (10:34). Pay rates are for FY 86 and are adjusted to FY 87 dollars by dividing base pay by 1.04, retirement pay by 1.039, and other expenses by 1.035 (10:92). These costs are added to the pool of costs accumulated in the previous paragraphs.

Total costs will be annualized in order to develop a pool of costs that represents one year of overhead activity.

HQ AFLC operations and information systems are reviewed to determine if there is a methodology for identifying the portion of support which can be attributed to reparable versus nonreparable items. If data are not available, expert opinion will be used to isolate and determine the support.

Identification of Overhead Base

The CSCS System of VAMOSC calculates costs for 30 different cost elements. The material management overhead is applied at a rate of 21.7 percent to 14 of these 30 elements. These cost elements are:

1. Base TCTO Material Costs
2. Base Direct Material Costs
3. Base Exchangeable Repair Costs (NSN)
4. Base Exchangeable Repair Costs (Engine)
5. Base Exchangeable Modification Costs (NSN)
6. Base Exchangeable Modification Costs (Engine)
7. Base Condemnation Spares Costs
8. Depot TCTO Material Costs
9. Depot Direct Material Costs
10. Depot Exchangeable Repair Costs (NSN)
11. Depot Exchangeable Repair Costs (Engine)

12. Depot Exchangeable Modification Costs (NSN)

13. Depot Exchangeable Modification Costs (Engine)

14. Depot Condemnation Spares Costs

Each of these 14 elements is to be reviewed to determine if material management costs are already being captured, the cost elements are independent of each other, a relationship exists between the bases and the costs being allocated, the bases used to calculate the overhead provides an equitable distribution of the benefits received, and if another base might provide a more accurate distribution. In addition, these 14 elements are examined to determine if the costs captured contain any elements that should be excluded before overhead is calculated.

The purpose of analyzing the VAMOSC material management overhead algorithm is to determine what combination of cost elements should form the base to allocate overhead. Once the base is identified cost for it can be collected and an overhead factor developed.

Overhead Factor

The overhead factor is calculated by dividing the overhead pool by the total cost of base/bases selected. Base costs are obtained from VAMOSC Component Support Cost System reports which accumulate data by mission design series. These base costs are annualized since only two quarters worth of data are available.

Data Sources

The first source of data is reports generated by the Component Support Cost System: RCS HAF-LEY (AR) 8104, MDS Logistics Support Costs, and RCS HAF-LEY (AR) 8113, Summary of Cost Elements. These reports summarize costs for each mission design series. A summary of these reports will provide a total of the 14 cost categories that CSCS System uses to allocate material management overhead.

The second source of data is budget reports. These include the 30 September Operating Budget Ledger and RC Manager Monthly Report for each ALC and HQ AFLC for fiscal years 1985-1986. This document provides actual expenditures and reimbursements by responsibility center, cost center, and PEC. Another source of information is the FY 87 and FY 88 ALCs and AFLC Financial Plans which contain additional information on actual expenditures for FY 86 and FY 85.

Limitations

1. The information generated by the CSCS is limited to two quarterly reports for the quarters 30 September and 31 December 1986. These are the first reports the system has generated since 1981.

2. The VAMOSC system is having problems tracking the engines exchanged for repair and modification. This in turn affects the cost elements Base and Depot

Exchangeable Repair Costs Engines and Base and Depot Exchangeable Modification Cost Engines.

3. The titles in the VAMOSC reports do not match the cost elements described in AFR 400-31, Visibility and Management of Operating and Support Cost Program (VAMOSC) Component Support Cost System. The audit trail between reports is limited. Documentation is currently being done by a contractor as the system is upgraded.

Assumptions

1. The VAMOSC system is processing costs in accordance with the algorithms described in AFR 400-31.

2. The material management function at the depot is operating at normal capacity. The two years of actual expenditures retrieved from the AFLC Financial Plan reflect normal capacity.

3. Costs reflected in the RCS HAF-LEY 8104 and 8113 reports are accurately calculated and distributed.

4. The depot material management function supports other DoD components, U.S. Government agencies, and foreign allies. The cost of this support can accurately be captured by excluding reimburseables from the analysis.

Summary

This chapter details the methodology used to develop an overhead pool and select a base for use in computing a factor for allocating depot material management

costs to reparable aircraft components and subsystems. Topics covered included the process by which material management organizations are identified and how cost of non-related activities within these organizations are eliminated. Details on cost collection were addressed and the basis by which the VAMOSC material management overhead algorithm would be analyzed was presented. Additional information discussed was sources of data, limitations, and assumptions.

Chapter IV presents findings and conclusions. Material management activities are identified and analyzed, costs are accumulated, analyzed and adjusted, and an overhead pool and overhead base is developed. The components of the VAMOSC material management overhead algorithm are analyzed and advantages and disadvantages of the current allocation bases are detailed.

IV. Analysis and Findings

Chapter Overview

This chapter details the process used to develop the overhead pool and select the base for allocating depot material management overhead to reparable aircraft components and subsystems. It begins by identifying and describing Air Force Logistics Command (AFLC) material management activities. The methodology for collecting, streamlining, and estimating costs for these organizations will be addressed next. The issue of material management support to reparable versus nonreparable items is also presented. Finally, the components of the VAMOSC algorithm for material management overhead are analyzed and the calculation of an overhead factor is addressed.

Air Force Logistics Command Overview

The primary function of the Air Force Logistics Command is to provide worldwide logistics support to commands that operate weapon systems. AFLC supports the active U.S. Air Force, Air Force Reserve, Air National Guard, and DoD agencies such as the Army and Navy, and allied countries through the Foreign Military Sales (FMS) Program. AFLC supports logistics requirements through four

management functions: procurement, material management, distribution and maintenance.

AFLC organizations are involved in over 600,000 contracting actions yearly. These organizations purchase services and materials needed to maintain weapon system readiness. These contract actions range from the purchase of computer chips to high cost modifications of aircraft, overhaul of systems, engineering and technical assistance and other equipment and services (33:3-4).

AFLC manages approximately 850,000 items. The command is responsible for requirements identification, procurement, quality assurance, storage, package and issue of this material. In FY 85, AFLC processed 4,178,395 requisitions (33:7).

The command is responsible for arranging "the movement of logistics cargo worldwide. Using aircraft, trains, trucks and even ships, AFLC assures the transport is available to support the logistics mission" (33:4).

Depot level maintenance is defined as:

> . . . the inspection, test, repair, modification, alteration, modernization, conversion, overhaul, reclamation or rebuild of parts, sub-assemblies, components, equipment, end items and weapon systems; the manufacture of critical nonavailable parts; and providing technical assistance to intermediate organizations, using and other activities [13:1-1].

Approximately 40 percent of AFLC's work force is engaged in maintenance. Field organizations and contractors perform maintenance, modification, and repair of

missiles, aircraft and exchangeable components for these systems (33:4).

Overhead Pool Development

There were several steps involved in the development of the material management overhead pool. The definition of material management was reviewed and applicable organizations within AFLC were identified. Organizational structures were reviewed to identify activities that do not support aircraft reparable items. The remaining activities formed the basis of the overhead pool. The next step was cost collection and analysis, which will be detailed later in this section.

Identification of Material Management Activities. Material management is the logistical process of getting the right material to the right people at the right time. There are several functions required to meet this objective: cataloging, standardization, requirements determination, procurement, inspection, quality control, packaging, mobilization planning, industrial readiness planning, and item management (8:435).

There are two distinct directorates at Headquarters AFLC and the five air logistics centers (ALCs) or depots, as they are commonly called, that perform material management activities. They are the directorates of Materiel Management (MM) and Distribution (DS).

At the ALCs, MM is involved in logistical support from two different perspectives. It is responsible for managing individual items and entire weapon systems.

Each ALC is assigned program management responsibility for certain weapon systems. For example, Ogden ALC is responsible for the F/RF-4 and F-16 aircraft; Peacekeeper, Minuteman, Titan II, and Maverick missiles; the GBU-15 and LGB laser guided bombs; and the small ICBM. In order to support assigned weapon systems, program managers continually coordinate with all ALCs. For example, the program manager for the F-16 must work with Oklahoma City ALC for flight instruments: Ogden ALC for wheels, brakes struts and tires; Sacramento for pneudraulics and hydraulics; and San Antonio ALC for life support equipment (33:9-18).

At each ALC, item managers are responsible for managing items related to assigned weapon systems. This includes managing reparable items which have been designated economically feasible to repair. The term reparable is interchangeable with the term exchangeable because nonworking reparable items are exchanged for items that are in working order. Other types of items managed are nonreparable and consumable items. Nonreparable items are too costly to repair and consumables are items that become part of an end product. A reparable item requires considerably more management than a consumable item or a nonreparable

item. An item manager monitors a reparable item from the time it enters the inventory, through its maintenance and repair during its lifetime to its final condemnation. Non-reparable items and consumables are managed using the economic ordering quantity (EOQ) theory. In other words, stock levels are predetermined so that the costs of carrying and ordering inventory are minimized.

Item management involves a variety of functions. Requirements for wartime and peacetime must be identified and continually monitored. New items must be cataloged and reliability and maintainability on assigned items must be continuously reviewed. In addition, performance standards must be developed.

MM's support begins during a weapon system's acquisition. During this stage, MM is responsible for insuring that a weapon system is supportable once it becomes operational. Throughout a weapon's life cycle, MM is responsible for insuring the reliability, maintainability, and effectiveness of assigned weapons systems and items.

In summary, the MM Directorate is responsible for requirements determination, cataloging, standardization, procurement, readiness planning, and item management.

The Directorate of Distribution (DS) at each ALC is responsible for storage, packaging, quality assurance, and issue of managed items. DS is a homogenous organization that processes material without distinction between

weapon system or customer. It is functionally organized by process as opposed to type of weapon system supported, such as aircraft, missile, munitions, etc.

Identification of Nonrelated Activities. Current organizational charts for each ALC were reviewed and branches and divisions not involved in aircraft or reparable item-related activities were identified. The following organizations were identified:

1. Oklahoma City (OC-ALC)--The Air Launch Cruise Missile System Program Branch and the Ground Launch Cruise Missile Program Branch in MM and the Fuels Support Branch in DS (51).

2. Ogden (OO-ALC)--Airmunitions and ICBM Program Management Divisions in MM and the Munitions Supply Division and Petroleum Branch in DS (48).

3. Sacramento (SM-ALC)--The CE and Space Management Division and the Petroleum Branch in DS (58).

4. San Antonio (SA-ALC)--The AF Cloth and Textile Office in MM and the Petroleum Branch and Det 37, DoD Dog Center in DS (61).

5. Warner Robins (WR-ALC)--The Global Positioning System JSSMO Branch and Missile System Program Management Branch in MM and the Petroleum Branch in DS (72.

The fuels/petroleum branches were deleted because they are not related to the repair of reparable items. The other branches were identified because they are not engaged in aircraft activities.

Cost Collection. The next phase of the analysis was to determine the costs of the organizations that form the base of the material management overhead pool. FY 86 and FY 85 costs were adjusted to FY 87 constant dollars which allows the comparison of expenditures in different years. Historical costs were annualized by averaging FY 85 and FY 86 to smooth the effects of fluctuation in spending patterns. The ultimate goal of this process was to develop a pool of costs that would represent one year of overhead activity.

Operation and Maintenance (O&M) Costs. Total operation and maintenance (O&M) costs for the ALC DS and MM Directorates were provided by ALC budget analysts using RC Managers Monthly Report or the Operating Budget Ledger for 30 September 1985 and 1986. Expenses for Depot Programmed Equipment Maintenance (DPEM) were excluded because these are the funds that MM pays the Directorate of Maintenance to work on items and engines managed. These funds are not used for MM operations. Thirty-five percent of WR-ALC's costs were deleted to account for computer support that is not related to reparables (69). For

comparison purposes, these costs have been adjusted to FY 87 dollars and are summarized in Table 1.

TABLE 1

ALCs OPERATION AND MAINTENANCE COSTS
(7; 18; 24; 39; 42; 44; 52; 66)
(000,000)

ALC	MM FY 86	MM FY 85	DS FY 86	DS FY 85
OC-ALC	$ 75,423	$ 79,888	$ 65,429	$ 62,040
OO-ALC	103,389	93,318	54,538	46,505
SA-ALC	101,298	89,870	61,042	61,564
SM-ALC	87,433	80,919	51,822	51,100
WR-ALC	59,156	64,528	57,539	66,182
Total	$426,699	$408,523	$300,370	$239,670

Division costs for organizations that are not supporting reparable aircraft components and subsystems have already been eliminated from these totals. For example, the costs for the Airmunitions and ICBM Program Management Divisions in MM and the Munitions Supply Division in DS at Ogden ALC are not reflected in the totals in Table 1.

Estimation and Elimination of Nonrelated Costs. There were two types of costs that had to be eliminated--costs of ALC organizations and specific expenditures not related to the support of reparable aircraft

items. The following paragraphs detail the methods used to capture these costs.

A review of the major program element codes (PEC) through which DS and MM are funded indicated that civilian pay expenses account for a majority of the total expenditures. DS is primarily funded through program element code (PEC) 71111 and MM through program element code (PEC) 71112. Following is a brief description of these PECs:

> 71111 - This PEC includes manpower and the associated cost specifically identified and measurable to supply operations, including receipt, storage, preservation, packing and issue of assigned stocks that are received from supply and repair points and issued to users worldwide [33:484].

> 71112 - This PEC provides for centralized management of logistics material required for active Air Force, Air Force Reserve, Air National Guard, other DoD components, other US Government agencies, and foreign allies. Provided are such logistics services as computation of requirements, provisioning, processing requisitions, cataloging and standardization, inventory control, property accountability, sustaining engineering, software modification, contract engineering technical services, preparation and printing of technical data, and the development of life cycle logistics support concepts for new weapon systems as they enter the acquisition phase [33:496].

The ALCs' FY 88 and FY 87 Financial Plans contained details on actual expenditures for FY 86 and FY 85. Appendix B contains a breakdown of PEC 71111 expenditures by each ALC for those fiscal years. Appendix C contains a similar breakdown for PEC 71112. In addition, these reports contained information on specific costs that should not be included in the material management overhead pool.

The following paragraphs summarize costs which should not be included in material management overhead pool. This included the costs of branches and divisions which are engaged in nonaircraft-related activities or which do not support reparable components and subsystems. Division costs were eliminated using year-end budget reports, either the RC Managers Monthly Report or the Operating Budget Ledger. The remaining costs which needed to be eliminated were estimated or identified in the ALC's Financial Plans.

Recall that civilian pay costs for branch operations were estimated based on 100 percent manning of authorized civilian positions. As of 28 February 1987, AFLC was authorized 88,967 civilian employees and had 90,617 for a 101 percent assigned rate (25:1-13). As mentioned in Chapter III, estimated civilian pay costs were computed by taking the number of authorizations times the pay rate from AFLCP 173-10, Cost and Planning Factors, adjusted to FY 87 constant dollars.

Oklahoma City ALC. The FY 87 and FY 88 OC-ALC Financial Plans were reviewed and there were expenditures identified that should not be included in the overhead pool. In FY 86, DS had costs of $68,000 for missile storage, $1,351,000 for the fuels management contract, and $4,266,000 for base vehicle maintenance. The corresponding

expenses in FY 85 were $55,000, $1,329,000, and $3,558,000 (49:110-187; 50:100-176). Fuels branches do not support reparable items so the cost for the Fuels Support (DSSP) had to be estimated and eliminated. The fuels management function is a contract operation and there are 11 civilians that manage this function. These expenditures are then increased proportionately to account for nonpay expenses.

The distribution function, which includes the fuels branches, at each of the ALCs is primarily funded by PEC 71111. Direct expenditures totaled $64,005,000 in FY 86 and $61,506,000 in FY 85 (see Appendix B). Civilian pay accounted for 82.3 percent of the total and 81.5 percent in FY 85. The next largest expenditure was supplies which accounted for 7.4 percent of total expenses in FY 86 and 9.1 percent in FY 85. A majority of this supply expense is for packing and crating supplies and not attributable to the fuels branch. Eliminating the supply expenses and the nonrelated costs identified in the Financial Plans, civilian pay costs would total 98.3 percent in FY 86 and 98.4 percent in FY 87 for an average of 98.35 percent. The 98.35 percent is more representative of the civilian pay expenses for DSSP because DSSP would have a higher ratio of civilian pay costs to total expenditures. Therefore, this percentage is used to estimate the nonpay expenses for the Fuels Branch. Estimated civilian pay costs totaled $196,584

(see Appendix D) so total expenses would total $199,882 ($196,584/98.35 percent).

There were two additional branches in MM for which operating costs had to be estimated--the Air Launch Cruise Missile System Program Branch (MMHC) in the B-52 and Missile System Program Management Divisicn, and the Ground Launch Cruise Missile System Program Branch (MMAC) in the Systems Division. Estimating costs for these branches posed several problems. They were both in divisions which supported other weapon systems. For example, in the Systems Division, there are system program management branches for A-7 and the E-4. The Production Management Branch and the Engineering and Reliability Branch support all three systems. Likewise, in the B-52 and Missile System Program Management Division, there is the ALCM System Program Branch and B-52 Program Management Branch. These two systems are supported by three branches: Production, Engineering and Reliability, and Materiel. A detailed study would be required to determine the level of support or costs which is directly attributable to each weapon system.

Costs for MMAC and MMHC were estimated based on assigned civilian authorizations. An analysis of OC-ALC expenditures in PEC 71112 (see Appendix C) showed that civilian pay accounted for 83.9 percent of total expenditures in FY 86 and 73.6 percent in FY 85. Supply expenditures decreased to approximately $2,124,000 in FY 86

compared to $10,908,000 in FY 85. This is a decrease of 413 percent and is unexplainable. For this reason, 83.9 percent is more representative of civilian pay expenses, and it is used in this research.

Estimated personnel cost totaled $702,806 for MMAC and MMHC (see Appendix D). Assuming this dollar figure accounts for 83.9 percent of the cost, 100 percent of the costs would total $836,813. This assumes that the other expenses in the branch are directly related to personnel expenses. It is intended that this additional amount capture some of the direct expenses for which details are not available and for some of the indirect costs from the support branches within the same division.

In summary, there were two separate types of costs identified as being not related to reparable aircraft components or subsystems, estimated branch costs and individual costs identified in the Financial Plans. Branch costs totaled $199,882 for DSSP and $836,813 for MMAC and MMAH. Costs identified in the Financial Plans for non-aircraft activities totaled $5,685,000 in FY 86 and $4,942,000 in FY 85.

Ogden ALC. The Airmunitions Management Division (MMW), the ICBM Program Management Division (MMG), Munitions Supply Branch (DSY) and the Petroleum Branch (DSSP) were identified as non-aircraft related activities.

Costs for MMW, MMG, DSY were eliminated using year-end budget reports. Costs for DSSP had to be estimated.

The costs for DSSP were calculated based on authorized civilian manning. An analysis of Ogden's direct obligations in program element 71111, similar to the one accomplished for Oklahoma City, support this method of estimation.

In FY 85, direct O&M obligations for program element 71111 totaled $57,058,000 and 88.2 percent of this total was civilian pay. In FY 86, direct obligations totaled $58,979,000 and civilian pay expenses accounted for 91.2 percent of the total. The next largest expenditure was for supplies, totaling 10.6 percent of direct obligations in FY 85 and 6.8 percent in FY 86 (see Appendix B). A majority of the supply expense was for packing, crating, and preservation supplies. If supply expenses are excluded, civilian pay expenses would total 97.8 percent of the expenses in FY 86 and 98.7 percent in FY 85. The average of these two percentages is 98.3 percent, and it is used to determine the nonpay-related expenses.

Estimated civilian pay costs totaled $1,886,052 (see Appendix D). Assuming that this cost is 98.3 percent of total expenditures and the remaining nonpay-related expenses are in direct relationship to the pay expenditures, total costs for this activity should be approximately $1,918,669.

San Antonio ALC. The Air Force Cloth and Textile Office (MMIC); Det 37, DoD Dog Center (DSK); and the Petroleum Branch (DSSP) were identified as nonaircraft-related activities. Costs for DSK were eliminated using year-end budget reports.

The Air Force Cloth and Textile Office is located at the Defense Personnel Support Center. MM pays the center for supplies, equipment and travel and the expenses totaled $24,000 in FY 85 and $29,000 in FY 86 (59:103-125; 60:113-139). Estimated civilian personnel costs are $356,660 and are documented in Appendix D.

DSSP costs were estimated based on civilian manning. An analysis of SA-ALC's direct obligations for PEC 71111 supports this methodology (see Appendix B). Excluding the costs of base vehicle maintenance which is not a cost related to material management ($3,070,000 in FY 85 and $3,444,000 in FY 86), PEC 71111 direct obligations for FY 85 totaled $61,136,000 and $60,866,000 for FY 86. Civilian pay costs accounted for 87.7 percent of this cost in FY 86 and 80.6 percent in FY 85. Supply costs accounted for 8.3 percent and 16.9 percent of the cost in FY 86 and FY 85 respectively. Assuming a majority of supply costs are not fuel related, civilian pay costs would account for 91.1 percent of expenses in FY 85 and 90.6 percent in FY 86 for an average of 90.9 percent.

Estimated civilian personnel costs for this activity is $2,118,355 (see Appendix D). Assuming there is a direct relationship between civilian pay and the remaining expenses, the total expenses for the branch are $2,330,424.

Total costs not related to material management or the support of reparable aircraft components and subsystems include $2,330,424 for DSSP, and Financial Plan costs of $3,070,000 in FY 85 and 3,444,000 in FY 86 for vehicle maintenance and MMIC costs totaling $24,000 and $29,000 in FY 85 and FY 86 for administrative expenses and annual civilian pay expenses of $356,660.

Sacramento ALC. There were costs for two organizations that had to be eliminated, the CE and Space Management Division (MMC) and the Petroleum Branch (DSSP). Costs for MMC were eliminated using year-end budget reports and DSSP costs were estimated.

The methodology for estimating DSSP costs is the same used for the Petroleum Branch at Ogden ALC. In FY 85, Sacramento's direct obligations in program element 71111 totaled $57,614,000 and $57,451,000 in FY 86. FY 85 civilian pay and supply costs totaled 82.6 percent and 14.2 percent respectively. FY 86 civilian pay expenses totaled 70.7 percent and supplies 6 percent. Like Ogden, a majority of the supply expense was for packing, crating and preservation supplies. Excluding supply costs,

civilian pay costs would account for 96.5 percent of total expenditures in FY 86 and 96.3 percent in FY 85 for an average of 96.4 percent (see Appendix B).

Estimated civilian pay cost for DSSP is $2,450,910 (see Appendix D). Assuming that this is 96.4 percent of the total cost and the remaining expenses are directly related to civilian pay, estimated total cost of this branch is $2,542,438.

Warner Robins ALC. The WR-ALC FY 87 and FY 88 Financial Plans were reviewed and there were costs identified in Directorate of Distribution that were not related to reparable aircraft components or subsystems. In FY 86, $232,000 was spent for drone storage and $2,558,000 for vehicle maintenance for a total of $2,790,000. In FY 85, drone storage cost $125,000 and vehicle maintenance $2,839,000 for a total of $2,964,000 (70:72-169; 71:130-243).

There were four activities identified to be eliminated from WR-ALC's costs. They were the: Global Positioning System (GPS) JSSMO Branch (MMAG), Missile System Program Management Branch (MMIL), Vehicle Management Division (MMV), and Petroleum Branch (DSSP). MMV was eliminated using year-end budget reports.

DSSP costs were estimated using the same methodology as was used for the petroleum branches in OO-ALC,

SA-ALC, SM-ALC. Direct expenditures for FY 86 totaled $70,869,000 and $70,805,000 in FY 85 (see Appendix B). A majority of the supply expense can be attributed to packing and crating and storage aids. Excluding nonrelated costs identified in the Financial Plans of $2,790,000 in FY 86 and $2,964,000 in FY 85 and supply costs for the corresponding fiscal years, direct obligations were $62,354,000 and $59,452,000, respectively. Based on this new total, personnel costs would account for 98.3 percent of the expenditures in FY 86 and 96.5 percent in FY 85 for an average of 87.4 percent.

DSSP estimated civilian pay cost is $1,771,617 (see Appendix D). Assuming this constitutes 97.4 percent and the remaining expenses are directly related to the civilian pay expenses, total operating costs for this branch would be $1,818,909.

The Missile Systems Program Management Branch (MMIL) is one of six branches in the Airborne Avionics, Missiles, and Weapon Item Management Division. The Global Positioning System JSSMO Branch (MMAG) is one of five branches in the Acquisition Division. Both of these branches receive varying degrees of support from the other branches that provide support in such areas as production, engineering and reliability, material support and provisioning. Without a detailed study, it is difficult to determine the degree of support received from each branch.

An analysis of WR-ALC's expenditures in PEC 71112 indicate 71.8 percent of the total expense in FY 86 was for civilian personnel and 59.6 percent in FY 85 (see Appendix D). The difference is due to the amount of technical data purchased. For example in FY 85, $24.3M was spent on technical data for aircraft. This same expense was $6.8M in FY 86. A review of the other ALCs expenditures in FY 86 indicated that civilian pay accounted for 77.8 percent - 83.9 percent (see Appendix D). The difference may be attributed to WR-ALC's computer requirements. In FY 86, WR-ALC had $5.3M of obligations for software modification and acquisition (71:178-243). Thus, 71.8 percent seems to represent the portion of total cost that civilian pay is.

Estimated civilian pay costs for MMAG and MMIL totaled $1,212,300. Based on the analysis in the preceding paragraph, this comprises 71.8 percent of the costs for these activities. The remaining 28.2 percent would equal $476,140 for a total of $2,198,898.

The Directorates of Distribution (DS) and Material Management (MM) both had costs identified as nonrelated to reparable aircraft components or subsystems. DS had the Petroleum Branch with an estimated annual cost of $1,818,909 and expenses for drone storage and vehicle maintenance totaling $2,964,000 in FY 85 and $2,790,000 in FY 86. MM had two branches, MMIL and MMAG, with an estimated cost of $1,688,440.

Headquarter's Support. The directorates of Distribution and Materiel Management at Headquarters AFLC directly support the corresponding activities at each ALC. DoD Instruction 7220.29, "Guidance for Cost Accounting and Reporting for Depot Maintenance and Maintenance Support" established the precedent for allocating command costs. It states that:

> . . . expenses of commands shall be allocated on the basis of beneficial and causal relationship between supporting and receiving activities. Such expenses should be allocated to the maximum extent possible [14:210-212].

Headquarters data were available for two years. Table 2 contains a breakdown of expenses for FY 85 and FY 86. Costs have been adjusted to FY 87 dollars.

TABLE 2

HEADQUARTERS O&M EXPENDITURES
(37:120-126; 38:128-134)
($000,000)

	MM	DS
FY 86	$11,963	$7,247
FY 85	$12,502	$7,812

Military Pay Expenses. Military pay expenses are not included in O&M expenses so they were estimated. HQ AFLC/XRMR provided authorizations by rank for the Distribution and the Materiel Management

Directorates at the ALCs and HQ AFLC. These totals included authorizations for nonrelated activities which were discussed previously. Authorizations for these activities were identified and eliminated using a report entitled, Air Force Logistics Command, Extended Unit Manpower Document. Appendix E shows the total authorizations for DS and MM activities at the ALCs and HQ AFLC and the manpower for the branches that were identified for deletion.

Composite rates from AFR 173-13, Air Force Costs and Planning Factors were used to calculate the pay expenses. These figures were in FY 86 dollars so they were adjusted to FY 87 constant dollars which allows the comparison of dollars which are spent in different years. Base pay had to be divided by 1.04, retirement pay by 1.037, and other expenses by 1.035 (10:99). Appendix F summarizes the cost for the remaining DS and MM organizations using the adjusted pay rates. DS had military pay costs totaling $7,003,942 and MM $13,944,612.

Summary of Costs. Once the costs were collected various operations were performed so that a single year of material management costs could be estimated. A single year's activity was needed to form the basis for developing the material management overhead factor. The following paragraphs summarize processes and steps taken to accumulate the costs for the overhead pool.

Basic Activity Costs. O&M costs for the Directorates of Distribution and Materiel Management Directorates at each ALC and HQ AFLC were collected for FY 85 and FY 86 and adjusted to FY 87 constant dollars. These costs excluded the costs of divisions not supporting reparable aircraft components and subsystems and are shown in Table 3.

TABLE 3

SUMMARY OF OPERATION AND MAINTENANCE COSTS
($000,000)

ALC	MM FY 86	MM FY 85	DS FY 86	DS FY 85
OC-ALC	$ 75,423	$ 79,888	$ 65,429	$ 62,040
OO-ALC	103,389	93,318	54,538	46,505
SA-ALC	101,298	89,870	61,042	61,564
SM-ALC	87,433	80,919	51,822	51,100
WR-ALC	59,156	64,528	57,539	66,182
HQ AFLC	11,963	12,502	7,247	7,032
Total	$438,662	$421,028	$307,617	$294,423

The FY 87 and FY 88 ALC Financial Plans were reviewed and costs not related to aircraft or reparable items were deleted. This category included expenses for such activities as vehicle maintenance and drone storage and the costs are summarized in Table 4. The narrative

TABLE 4

SUMMARY OF NONRELATED ACTIVITY COSTS
($000,000)

ALC	MM FY 86	MM FY 85	DS FY 86	DS FY 85
OC-ALC	$ -	$ -	$ 5,461	$4,601
SA-ALC	28	22	3,308	2,858
WR-ALC	-	-	$ 2,998	2,498
Total	$28	$22	$11,767	$9,957

description for these costs are contained in the section entitled "Estimation and Elimination of Nonrelated Costs." The totals have been adjusted to FY 87 constant dollars.

Table 4 totals were subtracted from Table 3 costs. These subtotals were then averaged to eliminate fluctuations in spending. Average annual costs for activities associated with the Material Management Directorates totaled $429,818,000 and $290,547 for the Directorates of Distribution.

Earlier in this analysis, certain organizations within the ALCs were identified as not supporting reparable aircraft components or subsystems. The costs for organizations at division level were eliminated using year-end budget reports and the costs in Table 3 reflect this. Costs for branch level activities were estimated based on

civilian personnel authorizations. Estimated branch costs are contained in Table 5.

TABLE 5

SUMMARY OF NONRELATED ORGANIZATIONAL COSTS
($000,000)

ALC	MM	DS
OC-ALC	$ 837	$ 200
OO-ALC	-	1,919
SA-ALC	357	2,330
SM-ALC	-	2,542
WR-ALC	2,199	1,688
Total	$3,393	$8,679

Table 5 totals were subtracted from the average annual costs calculated in the previous paragraph. The resulting figures totaled $426,425,000 for MM and $281,868,000 for DS.

Military pay costs are not included in O&M expenses. They were calculated base authorized manpower as of the fourth quarter 1987. Appendix F summarizes the calculation of these costs. Total costs in FY 87 dollars totaled $13,944,612 for distribution activities and $7,003,942 for material management activities. These costs were added to the totals in the preceding paragraph for a total of $433,428,942 for MM and $295,812,612 for DS. These costs

represented the annual cost for the depot material management pool.

Reparable Versus Nonreparable Support. Once costs were collected, a methodology had to be developed to divide support between reparable and nonreparable items. The Materiel Management and Distribution Directorates at the ALCs were examined to determine if the level of support could be determined.

Distribution Directorate. DS is organized by processes such as packing, quality control, inventory control, customer support, etc. The only ALC that has some product differentiation is Ogden with the Munitions Supply Division. Several different approaches and possible sources of information were considered that might breakout service by weapon system and reparable versus nonreparable support. They were current inventory, types of issues, and types of requisitions. The biggest problem encountered was that none of this information is maintained by weapon system.

DS tracks information for investment spares (reparables) and economic ordering quantity (EOQ) items which include nonreparables. EOQ items are those items whose stock levels are maintained so that ordering and holding costs are minimized. Issues and requisitions are tracked for both classes of material, but not by weapon system.

All items are processed using national stock numbers (NSN). The NSN contains the information necessary to classify an item as reparable or nonreparable and identifies what weapons system it belongs to. HQ AFLC/DSS is considering developing a program that categorizes items by weapon system, location, and customer.

A review of the Distribution Directorates at the ALCs identified an additional problem that affects cost allocation. The base level supply function has been incorporated into the ALCs distribution function. DS costs will be inflated unless the costs of this activity can be identified.

This analysis indicates that currently there is no feasible way to breakout the support that the Directorate of Distribution provides different weapon systems or reparable or nonreparable items. Costs for these activities were summarized and collected so that they could be used at a later date if a methodology is developed to allocate these costs.

Materiel Management. The reparable versus nonreparable issue also created problems when it came to determining the degree of MM support required for each class of materiel. The management of a reparable item is much more complex than a nonreparable item. In addition to the item managers, personnel in equipment and production

branches are involved in the continuous support of reparable items. Repair statistics are analyzed to identify deficiencies and develop repair factors. Production personnel schedule maintenance and negotiate repair for blocks of items with the Maintenance Directorate at each ALC. Item managers monitor stock levels and authorize purchases when stock levels fall below certain acceptable levels.

Nonreparable items have been classified as uneconomical to repair and are managed as EOQ items. EOQ items are managed based on diminishing supplies and require significantly less management time than do reparable items.

Several different alternatives were considered as possible methodologies for allocating MM support to reparable and nonreparables. Options were limited because there is no distinct break between the way these types of material are managed.

Items Managed. The number of reparable items versus nonreparable items managed was initially considered because this data is available. However, these data disregard the level of support required so it was deemed unacceptable.

Material Costs. Aircraft investment type replenishment spares and parts are purchased through program PB-15 in Appropriation 3010. Similar items are

purchased for missiles in Appropriation 3020. Historical expenditures for several years were available.

Material cost was not considered a good basis for allocating costs. A $100 item may require the same amount of support that a $1000 item does. This is particularly true if the $100 item is reparable and the $1000 item is nonreparable.

Expert Opinion. ALC personnel were contacted and asked to examine the entire MM organization and determine what percent of the operation was involved in the management and support of reparable versus nonreparable items. Persons interviewed were asked to consider direct and indirect support. All ALCs were contacted and four provided estimates.

Charles Wallace, Deputy Director Materiel Management at WR-ALC, excluded 35 percent of the MM activity stating that he had approximately 300 engineers engaged in various aspects of software support. Of the remaining 65 percent, he estimated 85 percent of the activity supported reparables and 15 percent nonreparables (69).

The next three estimates were provided by the Deputy Chiefs, Resource Management Division (MMM) at the Ogden, Tinker, and San Antonio ALCs MMM is involved in all aspects of the MM Directorate. This division insures that MM is in compliance with plans, programs, and

directives. From this perspective, the estimates are provided in Table 6.

TABLE 6

REPARABLE VERSUS NONREPARABLE SUPPORT (43; 55; 73)

	OC-ALC	OO-ALC	SA-ALC
Reparable Support	82%	80%	80%
Nonreparable Support	18%	20%	20%

The estimate for each ALC was relatively close. The average support for reparables was 81.75 percent and 18.25 percent. Thus, the overhead pool was reduced by 18.25 percent to show the level of support to nonreparable items. The remaining amount, $354,328,563 ($433,428,942 x 81.75 percent), was the material management overhead pool that is to be allocated.

Overhead Base Selection

The next step in the analysis was to develop a base to allocate the overhead pool. This included collecting costs of current bases used by VAMOSC to allocate material management, examining these bases to see their relationship to the overhead pool, and examining the bases to determine which ones provide an equitable distribution of overhead.

VAMOSC Costs. The VAMOSC material management algorithm was designed to allocate overhead by applying a factor of 21.7 percent to 14 different cost elements listed below:

1. Base Direct Material Costs
2. Depot Direct Material Costs
3. Base TCTO Material Costs
4. Depot TCTO Material Costs
5. Base Exchangeable Repair Costs (NSN)
6. Depot Exchangeable Repair Costs (NSN)
7. Base Exchangeable Repair Costs (Engine)
8. Depot Exchangeable Repair Costs (Engine)
9. Base Exchangeable Modification Costs (NSN)
10. Depot Exchangeable Modification Costs (NSN)
11. Base Exchangeable Modification Costs (Engine)
12. Depot Exchangeable Modification Costs (Engine
13. Base Condemnation Spares Costs
14. Depot Condemnation Spares Cost

There were limitations in collecting data for the above cost elements. Costs were not being collected for any of the exchangeable modification cost elements or for base exchangeable repair costs (Engine). In addition, information was only available for the fourth quarter in FY 86 and the first quarter of FY 87. Therefore, data was annualized to capture a year's worth of cost. Summary

of these costs is contained in Table 7. Costs have been rounded to the nearest thousand.

TABLE 7

SUMMARY OF VAMOSC COSTS
(26; 27; 28; 29)
($000,000)

Cost Element	Annual Cost
Base Direct Material	$153,974
Depot Direct Material	206,929
Base TCTO Material Costs	48,926
Depot TCTO Material Costs	114,065
Base Exchangeable Repair Costs (NSN)	293,556
Depot Exchangeable Repair Costs (NSN)	52,804
Depot Exchangeable Repair Costs (Engine)	9,868
Base Condemnation Spares Costs	51,474
Depot Condemnation Spares Costs	10,339

VAMOSC Material Management Overhead Algorithm. As stated earlier VAMOSC was designed to allocate overhead using 14 different bases/cost elements. These bases capture costs by component and subsystem. In addition, VAMOSC separates material management overhead (MMOH) into base and depot categories. The only distinction between base and depot MMOH is where the base costs are collected or where the engine or item is coming from. For example, an

exchangeable item being shipped from one depot to another for repair is a depot cost for MMOH. There is no level of distinction between the level of support required fcr base or depot.

Each of the 14 cost elements in VAMOSC material management overhead algorithm were analyzed to determine their relationship to the overhead pool, allocation, and what base or combination of bases would provide the most equitable allocation. Each of the cost elements is addressed separately in the following paragraphs.

Eight of the cost elements have two similar elements that are used to estimate costs: the average depot repair cost and average modification costs. These average costs are calculated using information collected by HO-36B, "DMIF (Depot Maintenance Industrial Fund) Cost Accounting/ Production Report." HO-36B was established in response to DoDI 7220.29-H "Guidance for Cost Accounting and Reporting for Depot Maintenance." The purpose of this instruction was to

> . . . establish a uniform cost accounting system for use in accumulating the cost of depot maintenance activities as they relate to weapon systems supported or items maintained [14:1-1].

VAMOSC sums 21 data elements (see Appendix G) from HO-36B by NSN/engine and then divides this total by the number of these items/engines that are being modified/ repaired to get an average repair/modification cost. Each

of the cost elements that use this average repair/modification are briefly described in the following paragraphs.

Base Exchangeable Repair Costs. The cost of this element is based on the number of items a base returns NRTS (not reparable this station) to depot, the portion of those returned that are returned to service, the average depot repair costs (NSN), and the percent of production that is repair.

Depot Exchangeable Repair Costs (NSN). This cost is a function of the number of exchangeables issued, percent of depot repair by NSN, average repair cost (NSN), and the percent of production that is repair.

Base Exchangeable Repair Costs (Engine). This cost element is calculated basically the same as exchangeable costs for NSNs. The only difference is that the costs are calculated for engines instead of NSNs.

Depot Exchangeable Repair Costs (Engine). This cost element is based on the number of engines shipped from depot to depot. This cost is calculated using the number of engines shipped, the average repair cost by type model series (TMS), and the percent of engine production (TMS) that is in repair.

Base Exchangeable Modification Costs (NSN). This element separates Class IV and Class V modifications. Cost is a function of items a base returns to depot NRTS, the percent repaired by the depot, average Class IV or Class V modification costs, and the percentage NSNs in maintenance production for modification.

Depot Exchangeable Modification Costs (NSN). The cost element is calculated similarly to base exchangeable repair costs (NSN). The only difference is that a separate average depot modification cost is calculated for Class IV and V modifications and the percent of NSNs depot production for modification as opposed to repair.

Base Exchangeable Modification Costs (Engine). The cost is similar to base exchangeable repair costs (Engine). Average depot modification costs for Class IV and V modifications are used and a percent of production attributed to modification is estimated.

Depot Exchangeable Modification Costs (Engine). The only difference in this cost element and depot exchangeable repair costs for engines is that an average modification costs for Class IV and V modifications are used and the percent of production attributed to modification is calculated.

The cost elements that use the average depot repair and modification cost have been described in the preceding paragraphs. The analysis of the data elements used to calculate these costs are applicable to all eight of those cost elements.

A review of the 21 elements that are used to calculate the average depot repair/modification cost indicate that beside direct labor and material, other costs such as depreciation, general and administrative overhead and services overhead are included. In addition, labor costs from the Material Management Directorate for work performance categories that include programming and planning support, maintenance technical engineering support, technical and engineering data, and technical and administrative training are captured by the data element called maintenance support costs.

There are advantages to using those cost elements which use an average repair/modification cost to allocate overhead. First of all, there is a direct relationship between MM at each ALC and the maintenance process involved in repairing/modifying these exchangeables. Production managers work directly with the ALC Maintenance Directorates to negotiate repair or modifications for blocks of engines or items.

Another advantage is that there is a common base among these elements. In other words, overhead isn't being

allocated using labor in one case and then labor and material together in another instance. The average repair/modification costs is also beneficial because it tends to smooth out the effect of high labor or material costs.

A limitation of using this base is that overhead costs are included in the average repair/modification costs. The HO-36B allocates overhead base on labor hours. The higher the labor, the higher the overhead which in turn increases the average repair/modification cost which ultimately drives up the MMOH allocated. Also, this base ignores other elements such as base/condemnation spares which might receive some material management support.

Base Direct Materials. "This cost element is calculated as function of material cost reported by the base supply and repair action for each work unit code" (11:68). "Direct material will either become part of the end item which is going undergoing maintenance or be consumed in the maintenance process" (14:330-332).

The disadvantage of using this cost is that material costs do not reflect the level of support required. Items requiring material of high costs would receive a greater burden of overhead, which may not be warranted. In addition, MM Directorate at the ALCs focus their support on depot maintenance as opposed to base level maintenance.

Depot Direct Material Cost. This algorithm calculates depot direct material costs based on an average material costs per hour. Direct material costs through the Depot Maintenance Industrial Fund and direct material funded through other appropriations are added and then divided by the production hour for direct military and civilian labor to get an average material costs per hour.

The disadvantage to using this cost element as a base is that material costs are a function of hours. The higher the number of hours, the lower the material costs and the lower the MMOH. In addition, material costs do not reflect the level of support required. If a relationship exists between MM activities and direct materials, it is very limited.

Base TCTO Material Costs. This cost element represents the cost of Technical Time Change Order (TCTO) material. The cost is calculated based on the number of kits issued and the cost per kit. Each kit has a unique national stock number (NSN) and is managed by MM.

The advantage to using TCTO material costs is that there is a direct relationship between TCTO material and MM because the kits are managed by MM. A TCTO change is a one-time change, modification, inspection or addition to an existing piece of equipment. The relationship is

limited in the sense that once the kits are used they would no longer be monitored.

Disadvantages of using this base is that there is no relationship between the cost of the TCTO kits and the level of support provided by material management activities. Kits that cost more would receive more of the overhead even though they may not be receiving management support.

Depot TCTO Material Costs. This cost is calculated based on the cost of modification kits for Class IV, Class V, and other modifications during programmed depot maintenance (PDM). The advantages and disadvantages of using these costs as a basis for allocating material management overhead are the same as for Base TCTO Costs.

Base Condemnation Spares. "Base condemnation spares is the cost of replacing items failed at the base and subsequently condemned at base or depot" (14:[illegible]). The cost is a function of the sum of base condemnations plus base items classified as NRTS (not repairable this station) and condemned at the depot times the unit price for the replacement.

There is a direct relationship between condemnation spares and item managers at the ALCs. The item manager must monitor condemnations so that when inventories for

reparables fall below required levels, they can be replenished.

The disadvantage of using this cost element as a base is that higher cost items would receive a greater portion of the overhead. As discussed earlier, material costs are not necessarily a good indicator of the level of support required.

Depot Condemnation Spares. This cost element is a function of the number of exchangeable issued, item unit prices, and a depot condemnation percentage. The analysis of this element is the same as that of base condemnation spares. The management process in MM is the same and the disadvantages of using this as an allocation base are exactly the same.

Conclusion. This analysis indicated that the eight cost elements that use an average depot repair/modification cost would provide the most equitable allocation of overhead because they have a direct and continuing relation to the ALC Materiel Management Directorates.

These cost elements met several of the criteria for allocating overhead costs that was identified in the literature review. Fairness and equity was one of the criteria. The cost elements that use the average repair/modification cost have a similar base that will result in a more equitable distribution of overhead. Two other criteria

AD-A187 905 AN ANALYSIS OF THE DEPOT MATERIAL MANAGEMENT OVERHEAD IN THE VAMOSC (VISI..(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF SYST.. C J SISCO 2/2

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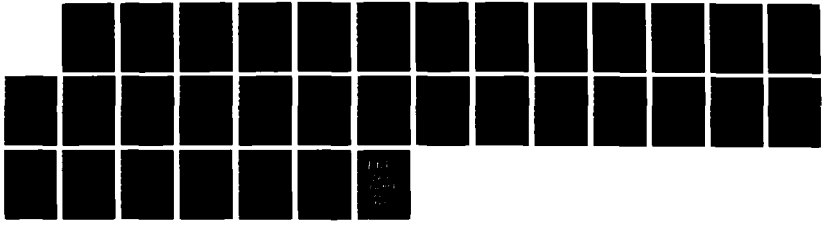

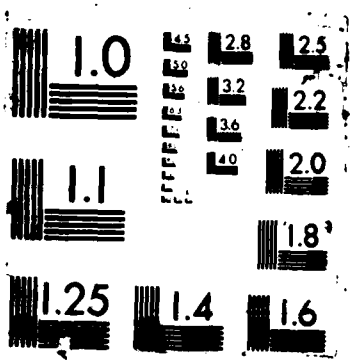
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were benefit and cause. The cost elements selected involve depot repair and modification. There is a direct relationship between material management and this type of maintenance because the Materiel Management (MM) Directorates at the ALCs monitor the reparables waiting for repair and negotiate work with the Maintenance Directorate. In other words, there is more of a direct relationship with material management activities when the repair work is performed at the depot as opposed to the base.

There are limitations to using these bases because they only allocate overhead costs to items repaired at the depot. There may be components and subsystems receiving material management support that are not included in this category. For example, items repaired, modified or condemned at base level would not be charged overhead when they are actually receiving support. Without a detailed study it is difficult to quantify this support.

The other cost elements in VAMOSC were material related. These elements had a limited relationship with MM but they were not considered good indicators of the level of support required.

Overhead Factor Calculation

An overhead factor could not be calculated because costs are currently not being collected for five out of the eight bases selected to allocate the overhead. Once

problems are corrected with these cost elements/bases, a factor can be determined using the overhead pool developed in this analysis.

Summary

This chapter identified the directorates/organizations that are involved in material management activities at HQ AFLC and the ALCs. It also detailed how non-aircraft related activities were identified and how their costs were eliminated using year-end budget reports or by estimation.

Civilian pay formed the basis for estimating cost of the branch activities to be eliminated since year-end budget reports did not identify the costs by branch. This determination resulted from an analysis of the major program elements that fund material management activities.

There were limitations using this estimation methodology. Percentages derived using this methodology only represent a macro perspective of the organization. No consideration is given to the individual activities within the organization. It assumes that expenditures have a direct relationship to the number of personnel assigned. This may be true for travel and supplies, but it doesn't necessarily apply to expenditures like the purchase of technical data. Overall, impact of this methodology might

be an overstatement of the overhead pool since costs of deleted organizations are possibly understated.

The issue of reparable versus nonreparable support was addressed. Expert opinion formed the basis of this analysis.

Costs were collected, analyzed, reduced, transformed to FY 87 dollars, annualized and total dollar costs was derived that will form the basis for the overhead pool and the base against which overhead costs will be allocated.

The VAMOSC material management overhead algorithm was reviewed. Each cost element used as a base in this algorithm was examined and the advantages and disadvantages of its usage was addressed and bases were selected to allocate the overhead.

Chapter V will present the conclusion of this analysis. Areas covered included: conclusions, recommendations, and suggested areas of further study.

V. Conclusions and Recommendations

Overview

This chapter presents findings, conclusions, and limitations of this study that resulted from the analysis which is documented in Chapter IV. Recommendations for further study are presented at the end of this chapter.

Conclusions

The purpose of this research was to develop and document a factor to allocate depot material management overhead. These overhead costs are allocated to reparable aircraft components and subsystems because they are part of the operating and support costs required to maintain them. Material management activities require large expenditures to operate, and it is appropriate that these costs be identified and allocated in the VAMOSC System.

Limitations. The VAMOSC System collects and allocates costs to reparable aircraft items. Non-aircraft related activities that were specifically identified as divisions or branches could be eliminated using year-end budget reports and estimated costs.

Cost estimations were based on civilian pay and possibly understate total expenses. In addition, service branches often provide support to missiles and aircraft.

The degree of support attributed to each weapon system could not be estimated without a detailed study. The impact of these two situations was a possible overstatement of the overhead pool, an increase in the factor used to allocate the overhead, and subsequently an overallocation of costs.

Information from the Component System Cost System was limited. Only two quarters worth of data have been generated since 1981, the fourth quarter of FY 86 and the first quarter of FY 87.

Five of the bases that VAMOSC uses to calculate material management overhead are not having costs collected for them because of problems with data collection. These cost elements are:

1. Base exchangeable repair costs (Engine)
2. Base exchangeable modification costs (Engine)
3. Base exchangeable modification costs (NSN)
4. Depot exchangeable modification costs (Engine)
5. Depot exchangeable modification costs (NSN)

The amount of overhead allocated by the current algorithm and cost factor could not be analyzed since only 9 of the 14 cost elements had cost data. Problems with these elements will not be corrected until sometime during FY 88.

ALC material management activities are directly or indirectly engaged in supporting reparable and non-reparable items. There was no way to divide ALC

distribution activities between these two classes of material. Distributions functions provide support regardless of the weapon system or the class of material. Expert opinion was used to separate this support for the Material Management Directorates at the ALCs. Estimates were provided, but they were not based on detailed studies.

Results. After data collection, analysis, and reduction, an average yearly operational cost was developed for the Material Management and Distribution Directorates at the five air logistics centers and HQ AFLC. MM costs totaled $354,328,563 for support to reparable aircraft components and subsystems and DS totaled $295,812,612 for support to aircraft and non-aircraft reparable and non-reparable items.

These figures represent an average of FY 86 and FY 85 obligations expressed in FY 87 constant dollars. Non-aircraft activities for MM have been eliminated. Military pay was added and MM totals were adjusted to reflect reparable support of 81.75 percent.

The VAMOSC Depot Material Management Overhead algorithm was reviewed and eight cost elements were identified as the most appropriate and equitable bases for allocating material management costs. These elements were:

1. Base Exchangeable Repair Costs (NSN)
2. Base Exchangeable Repair Costs (Engine)

3. Base Exchangeable Modification Costs (NSN)

4. Base Exchangeable Modification Costs (Engine)

5. Depot Exchangeable Repair Costs (NSN)

6. Depot Exchangeable Repair Costs (Engine)

7. Depot Exchangeable Modification Costs (NSN)

8. Depot Exchangeable Modification Costs (Engine)

These eight cost elements use an average depot repair or modification cost. This average cost smooths out the effect of material versus labor since both elements are included. Another advantage is that there is commonality among the elements. In other words, the same base is being used to allocate overhead. If production is increased for one element, then their share of the overhead would increase because the base is a function of number of items/engines processed. Finally, there is a continuous relationship between MM and the process that causes these costs. For reparables, MM focuses its support on depot level maintenance and these cost elements capture that relationship.

There are limitations to using these bases. First of all, Material Management Directorate expenses are used to calculate the average depot repair modification costs and this has the effect of double counting costs. Next, these bases may ignore components or subsystems that are receiving material management support. Items repaired, modified and condemned at base level are not allocated

overhead costs when they may be actually receiving support. Without a detailed study it would be hard to quantify this support.

Recommendations

Costs for the distribution activities at the ALCs and HQ AFLC cannot be allocated based on available information. Costs have been collected, and it is recommended that this area be examined further. The large expenditures required to support this activity justify further analysis in this area.

The VAMOSC System should allocate MM overhead using the costs elements that use an average repair/modification costs. This average cost needs to be adjusted so MM costs are not included in its totals.

Costs are only being collected for three out of eight of the cost elements. Until problems are corrected with these eight cost elements it is recommended that no material management overhead costs be allocated.

Additional research is needed on how to allocate material management overhead to components and subsystems repaired at base level. There are two approaches that might solve this problem. First, determine if the depot material overhead pool can be divided between base and depot level support and then select the appropriate bases for allocating each type of support. Second, use the eight

bases identified in this analysis plus another base which would represent support to base maintenance activities. The VAMOSC System has several other overhead categories that would be good candidates for analysis. They are: base TCTO overhead, base maintenance overhead, base supply management and base other support general costs.

An additional cost that should be considered for overhead allocation is contracting support. AFLC "field organizations engage in more than 600,000 contracting actions yearly" (31:5). The support to reparable aircraft subsystems and components would include the purchase of individual items and the acquisition of contractor support for maintenance.

Closing Remarks

This study only analyzed a small part of the VAMOSC System. There's increased congressional and DoD interest in Operating and Support Costs (O&S). The goal of VAMOSC is to make these O&S costs visible at the lowest level possible. Further studies will enhance reliability and increase the credibility of this system.

Appendix A: Definitions

Class IV Modification

A modification necessary to correct equipment deficiency or installation deficiency that affects maintainability or reliability (flight safety or reliability) (8:123).

Class V Modification

A modification required to improve system operational capability (change in mission) (8:123).

Direct Costs

Any cost which is identified specifically with a particular final cost objective (14:C-2).

Expenses

Expenses include labor costs, material consumed in use, and services received, except when those costs are incurred in the production or construction of investment items (12:2).

Funded Costs

Costs reimbursable to the depot maintenance activity from funds cited on the reimbursable order authorizing performance of maintenance (14:C-2).

Investment Costs

Investment costs are those costs usually associated with acquisition of equipment and real property (12:3).

Life Cycle Costs

An approach to costing that considers all cost (government and contractor) incurred during the projected life of a system, subsystem, or component. It includes the total cost of ownership over the system life cycle including the cost to develop, produce, operate, support, and dispose of a system, subsystem, or component (3:A-44).

Modification

An alteration, conversion or modernization of a major end item or equipment which changes or improves the basic character, purpose or operational capacity in relation to effectiveness, efficiency or safety (12:5).

Operating & Support (O&S) Costs

The added or variable of costs personnel, materials, facilities, and other items needed for the peacetime operation, maintenance, and support of a system during activation, steady state of operation, and disposal (5:A-51).

Reparable

Unserviceable items which can be economically restored to serviceable condition (8:581).

Time Compliance Technical Order

Directives issued to provide instructions to Air Force activities for accomplishing "one-time" changes, modifications, or inspections of equipment or installation of new equipment (8:705).

Unfunded Costs

Costs which legally or administratively cannot be reimbursed to the depot maintenance activity, e.g., military labor and investment items procured by appropriations available for such procurement (14:C-3).

Appendix B: FY 85 and FY 86 Expenditures-- Program Element 71111

($000,000)

FY 86

Title	OC-ALC	OO-ALC	SA-ALC	SM-ALC	WR-ALC
Civ Pay	$52,670	$53,794	$53,632	$52,239	$61,309
Travel Pay	148	431	357	190	301
Trans of Things	1	31	225	-	1
Utilities/Rents	133	58	1,064	109	32
Equip Maint Comm	4,278	106	3,579	47	2,679
Equip Maint DoD	-	8	-	-	-
Purch Service	1,681	345	111	1,192	535
Supplies	4,744	4,002	5,109	3,502	5,725
Equipment	350	204	233	335	287
Total	$64,005	$58,979	$64,310	$57,614	$70,869
Civ Pay/Total	82.3%	91.2%	83.4%	90.7%	86.5%

FY 85

Title	OC-ALC	OO-ALC	SA-ALC	SM-ALC	WR-ALC
Civ Pay	$50,130	$50,337	$49,093	$47,432	$57,380
Travel Pay	200	437	424	212	280
Trans of Things	1	11	-	-	-
Utilities/Rents	170	11	483	176	3
Equip Maint Comm	3,580	73	3,083	84	2,944
Equip Maint DoD	-	15	-	-	-
Purch Service	1,536	98	145	1,146	1,499
Supplies	5,604	6,035	10,339	8,206	8,389
Equipment	285	41	639	195	310
Total	$61,506	$57,058	$64,206	$57,451	$70,805
Civ Pay/Total	81.5%	88.2%	76.5%	82.6%	81.0%

Key: OC-ALC - Oklahoma City Air Logistics Center
OO-ALC - Ogden Air Logistics Center
SA-ALC - San Antonio Air Logistics Center
SM-ALC - Sacramento Air Logistics Center
WR-ALC - Warner Robins Air Logistics Center

Description: The major source of funding for the Directorate of Distribution at the five air logistics centers is program element 71111. This appendix shows FY 86 and FY 85 actual expenditures for various classes of expenses. In addition, the ratio of civilian pay to total expenditures is shown.

Source: FY 87 and FY 88 Financial Plan for all air logistic centers (46:98; 47:122; 49:110; 50:100; 56:80; 57:79; 59:80; 60:79; 70:72; 71:130).

Appendix C: FY 85 and FY 86 Expenditures-- Program Element 71112

($000,000)

FY 86

Title	OC-ALC	OO-ALC	SA-ALC	SM-ALC	WR-ALC
Civ Pay	$ 90,670	$60,762	$77,837	$74,639	$ 7,272
Travel Pay	2,095	2,276	2,557	2,328	2,523
Trans of Things	-	6	155	91	8
Utilities/Rents	-	-	-	94	-
Printing/Reprod	997	714	1,380	1,172	2,704
Equip Maint Comm	763	938	537	2,539	1,955
Purch Service	11,270	6,387	14,148	6,887	18,402
Supplies	2,124	1,308	2,320	2,899	3,906
Equipment	188	173	280	210	780
Total	$108,107	$72,564	$99,221	$90,589	$107,550
Civ Pay/Total	83.9%	83.7%	78.4%	82.1%	71.8%

FY 85

Title	OC-ALC	OO-ALC	SA-ALC	SM-ALC	WR-ALC
Civ Pay	$ 80,446	$51,837	$ 76,450	$64,646	$ 67,299
Travel Pay	2,356	2,284	2,902	2,791	2,638
Trans of Things	10	26	9	91	3
Utilities/Rents	-	-	161	204	-
Equip Maint Comm	748	775	383	2,059	1,392
Purch Service	13,379	11,206	11,361	10,048	37,482
Supplies	10,908	3,260	6,971	3,990	1,398
Equipment	658	294	1,056	432	730
Total	$109,254	$70,167	$100,592	$85,483	$112,873
Civ Pay/Total	73.6%	73.9%	76.0%	75.6%	59.6%

Key: OC-ALC - Oklahoma City Air Logistics Center
OO-ALC - Ogden Air Logistics Center
SA-ALC - San Antonio Air Logistics Center
SM-ALC - Sacramento Air Logistics Center
WR-ALC - Warner Robins Air Logistics Center

Description: The major source of funding for the Directorate of Materiel Management at the five air logistics centers is program element 71112. This appendix shows FY 86 and FY 85 actual expenditures for various classes of expenses. In addition, the ratio of civilian pay to total expenditures is shown.

Source: FY 87 and FY 88 Financial Plan for all air logistic centers (46:135; 47:125; 49:135; 50:125; 56:103; 57:122; 59:195; 60:156; 70:117; 71:178).

Appendix D: Civilian Pay Costs

Oklahoma City Air Logistics Center

Fuels Support Branch (DSSP):

Category	Pay Rate	Auth Personnel	Total Cost
GS	$28,083	7	$196,584

Air Launch Cruise Missile System Program Branch (MMHC) and Ground Launch Cruise Missile Program Branch (MMAC):

Category	Pay Rate	Auth Personnel	Total Cost
GS	$28,083	25	$702,086

Ogden Air Logistics Center

Petroleum Branch (DSSP):

Category	Pay Rate	Auth Personnel	Total Cost
GS	$28,670	14	$ 401,376
WG	$27,131	45	$1,220,905
WS	$37,682	7	$ 263,771
			$1,886,052

Sacramento Air Logistics Center

Petroleum Branch (DSSP):

Category	Pay Rate	Auth Personnel	Total Cost
GS	$28,233	14	$ 395,257
WG	$30,321	57	$1,728,312
WL	$35,813	1	$ 35,813
WS	$41,647	7	$ 291,527
			$2,450,910

San Antonio Air Logistics Center

Petroleum Branch (DSSP):

Category	Pay Rate	Auth Personnel	Total Cost
GS	$27,435	14	$ 384,096
WG	$23,393	63	$1,473,782
WL	$28,125	1	$ 28,125
WS	$33,193	7	$ 232,352
			$2,118,355

San Antonio Air Logistics Center

Air Force Cloth and Textile Office (MMIL):

Category	Pay Rate	Auth Personnel	Total Cost
GS	$27,435	13	$372,706

Warner Robins Air Logistics Center

Petroleum Branch (DSSP):

Category	Pay Rate	Auth Personnel	Total Cost
GS	$28,193	12	$ 338,316
WG	$28,969	37	$1,071,862
WL	$34,980	8	$ 279,839
WS	$40,799	2	$ 81,599
			$1,771,617

The Global Positioning System JSSMO Branch (MMAG) and the Missile System Program Management Branch (MMIL):

Category	Pay Rate	Auth Personnel	Total Cost
GS	$28,193	56	$1,578,808

Key: GS - General Schedule
WG - Wage Grade
WL - Wage Leader
WS - Wage Supervisor

Description: This appendix presents the civilian personnel costs for organizations in the Directorates of Materiel Management and Distribution at each of the air logistics centers which are not engaged in supporting reparable aircraft components and subsystems.

Source: Pay rates were taken from AFLCP 173-10, Cost and Planning Factors (30:25). Manpower authorizations were taken from the Air Force Logistics Command Extended Unit Manpower Document and included authorizations as of the fourth quarter 1987 (32:1-555).

Appendix E: Military Manpower Authorizations

Directorate of Distribution

The following chart details the military manpower authorizations for the Directorate of Distribution at each of the air logistics centers and HQ Air Force Logistics Command.

Auth Rank	OC-ALC	OO-ALC	SA-ALC	SM-ALC	WR-ALC	HQ AFLC	TOTAL
GEN	-	-	-	-	-	1	1
COL	-	-	1	-	1	3	5
LTC	-	1	1	2	2	2	8
MAJ	1	2	2	-	-	1	6
CPT	-	4	4	1	2	3	14
LT	2	1	-	-	-	1	4
CMS	-	1	-	-	-	1	2
SMS	1	3	2	-	-	-	6
MSG	1	14	10	4	4	3	36
TSG	5	21	18	10	5	1	60
SSG	27	49	38	21	22	-	157
GST	29	61	34	16	22	-	162
AlC	38	105	47	19	33	-	242

The next chart shows the manpower authorizations for distribution organizations that are not engaged in support of reparable aircraft components or subsystems.

Auth Rank	OO-ALC DSSP	OO-ALC DSY	WR-ALC DSSP	TOTAL
LTC	-	1	-	1
MAJ	-	1	-	1
CPT	-	2	-	2
LT	-	1	-	1
CMS	-	1	-	1
SMS	-	2	-	2
MSG	1	11	-	12
TSG	1	13	-	14
SSG	1	36	-	37
GST	9	38	-	47
AlC	15	37	14	66

Directorate of Materiel Management

The following chart details the military manpower authorizations for the Directorate of Distribution at each of the air logistics centers and HQ Air Force Logistics Command.

Auth Rank	OC-ALC	OO-ALC	SA-ALC	SM-ALC	WR-ALC	HQ AFLC	Total
GEN	-	1	-	1	1	1	3
COL	-	7	1	-	5	5	18
LTC	4	5	2	3	2	3	19
MAJ	6	5	3	6	4	10	34
CPT	6	17	7	6	11	8	55
LT	1	15	3	5	4	2	30
CMS	-	-	1	-	-	-	1
SMS	-	-	1	1	-	1	3
MSG	1	2	3	1	1	-	8
TSG	2	3	-	1	1	1	8
SSG	-	2	-	1	1	2	6
SGT	-	1	-	-	-	1	1

The next chart shows the manpower authorizations for distribution organizations that are not engaged in support of reparable aircraft components or subsystems.

Auth Rank	OC-ALC MMAC	OC-ALC MMHC	OO-ALC MMW	OO-ALC MMG	SM-ALC MMC	WR-ALC MMAG	WR-ALC MMIL	WR-ALC MMV	Total
COL	-	-	1	2	1	-	-	1	5
LTC	1	1	-	2	1	1	1	2	9
MAJ	-	-	3	2	-	1	-	1	7
CPT	2	-	6	11	6	1	-	1	27
LT	-	-	1	3	3	-	-	3	10
SMS	-	-	-	-	-	-	-	1	1
MSG	-	-	1	1	-	-	-	-	2
TSG	-	-	1	1	-	-	-	-	2
SSG	-	-	-	-	1	-	-	-	1

Key: OC-ALC - Oklahoma City Air Logistics Center
OO-ALC - Ogden Air Logistics Center
SA-ALC - San Antonio Air Logistics Center
SM-ALC - Sacramento Air Logistics Center
WR-ALC - Warner Robins Air Logistics Center
HQ-AFLC - Headquarters Air Force Logistics Command
DSSP - Petroleum Branch
DSY - Munitions Supply Division
MMAC - Ground Launch Cruise Missile System Program Branch
MMHC - Air Launch Cruise Missile System Program Branch

MMW - Air Munitions Management Division
MMG - ICBM Program Management Division
MMC - CE and Space Management Division
MMAG - Global Positioning System JSSMO Branch
MMIL - Missile System Program Management Branch
MMV - Vehicle Management Division

Source: Manpower authorizations were taken from HQ Air Force Logistics Command Extended Unit Manpower Document and reflect military authorizations as of the fourth quarter FY 87 (32:2-555).

Appendix F: Military Pay Costs

Directorate of Distribution (DS)

Auth Grade	Tot DS Auth	Less Non-related	Tot Auth	Pay Rate	Total Cost
GEN	1	0	1	$100,372	$100,372
COL	5	0	5	$88,222	$441,109
LTC	8	1	7	$75,702	$529,914
MAJ	6	1	5	$65,304	$326,518
CPT	14	2	12	$53,269	$639,229
LT	4	1	3	$40,824	$122,473
CMS	2	1	1	$50,597	$50,597
SMS	6	2	4	$42,922	$171,688
MSG	36	12	24	$37,071	$889,692
TSG	60	14	46	$31,688	$1,457,657
SSG	157	37	120	$26,602	$3,192,292
SGT	162	47	115	$22,851	$2,627,887
AlC	242	66	176	$19,291	$3,395,185
TOTAL	703	184	519	-	$13,944,612

Directorate of Material Management (MM)

Auth Grade	Tot MM Auth	Less Non-related	Tot Auth	Pay Rate	Total Cost
GEN	3	0	3	$100,372	$301,115
COL	18	5	13	$88,222	$1,146,882
LTC	19	9	10	$75,702	$757,020
MAJ	34	7	27	$65,304	$1,763,200
CPT	55	27	28	$53,269	$1,491,534
LT	30	10	20	$40,824	$816,484
CMS	1	0	1	$50,597	$50,597
SMS	3	1	2	$42,922	$85,844
MSG	8	2	6	$37,071	$222,423
TSG	8	2	6	$31,688	$190,129
SSG	6	1	5	$26,602	$133,012
SGT	2	0	2	$22,851	$45,702
AlC	0	0	0	$19,291	$0
TOTAL	187	64	123	-	$7,003,942

Appendix G: Average Depot Repair/Modification Cost Elements

1. Production Cost (Direct Civilian Labor)
2. Other Costs (Direct Civilian Labor)
3. Production Cost (Direct Military Labor)
4. Other Costs (Direct Military Labor)
5. Direct Material Cost (Funded)
6. Investment (Direct Material Costs--Unfunded)
7. Exchanges (Direct Material Costs--Unfunded)
8. Modification Kits (Direct Material Costs--Unfunded)
9. Expense (Direct Material Costs--Unfunded)
10. Other Direct Cost (Funded)
11. Operation Overhead (Funded)O
12. Operation Overhead (Unfunded)
13. G&A Expense (Funded)
14. Investment (Government Furnished Material)
15. Exchange (Government Furnished Material)
16. Modification Kits (GFM)
17. Expense (GFM)
19. Government Furnished Services (Funded)
20. Government Furnished Services (Unfunded
21. Maintenance Support Cost (Organic--Unfunded)

Description: The above cost elements are collected by national stock number or engine and used in VAMOSC Component Support Cost System (CSCS) to calculate an average depot repair cost.

Source: Details concerning the VAMOSC algorithm that uses these cost elements is contained in AFR 400-31, Volume IV.

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Vita

Captain Cynthia Jo Lucas Sisco was born on 16 February 1951 in San Antonio, Texas. She graduated from Mitchell High School in Colorado Springs, Colorado in 1969 and then attended the University of Colorado where she received a Bachelor of Arts degree in Mathematics in 1974. After graduation she worked as compensation manager for American Television and Communications Corporation from 1973 to 1978. She received a commission in the United States Air Force through Officers Training School in August 1979 and entered the Air Force as a cost and management analysis officer. Her first duty assignment was as Chief, Cost and Management Analysis Branch for the 22nd Bomb Wing, March Air Force Base, California, from November 1979 until December 1981. She held the same position at the 90th Strategic Missile Wing, Francis E. Warren Air Force Base, Wyoming from January to December 1982. In January 1983, Captain Sisco was assigned to the Air Force Electronic Warfare Center, Kelly Air Force Base Texas, where she ultimately served as the Chief of Management Support Branch. In July 1985, she transferred to Headquarters Electronic Security Command, Kelly Air Force Base Texas, as a budget analyst where she served until she entered the School of Systems and Logistics, Air Force Institute of Technology, in May 1986.

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This research attempts to validate and document the factor used by the Visibility and Management of Operating and Support Cost (VAMOSC) System to allocate depot material management overhead to reparable aircraft components and subsystems. VAMOSC currently applies a factor of 21.7 percent to 14 different cost elements to allocate this cost.

This analysis defined material management and identified organizations engaged in this function at Headquarters Air Force Logistics Command and its air logistics centers at Oklahoma City, Ogden, San Antonio, Sacramento, and Warner Robins. Costs were collected, analyzed and refined to include only those costs related to the support of reparable aircraft items. This process resulted in the development of an overhead pool for material management activities.

The current VAMOSC algorithm was reviewed to determine the most equitable base for allocating material management overhead. An overhead base could not be developed because VAMOSC is currently experiencing problems with data collection. Since costs for an overhead base could not be collected, an overhead allocation factor could not be developed or documented.

Once these problems are corrected, the cost collected for this analysis will provide the basis for calculating a factor to allocate depot material management. In addition, this research documented a methodology for computing this factor.

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